United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Forest Service
and the Missouri
Agricultural
Experiment Station

Soil Survey of Christian County, Missouri

How To Use This Soil Survey

General Soil Map

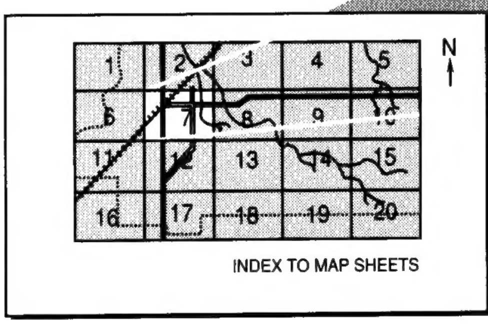
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

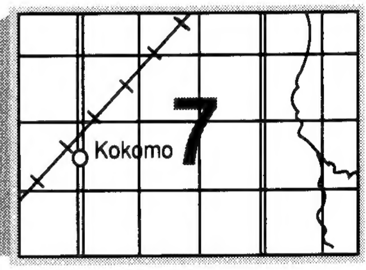
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

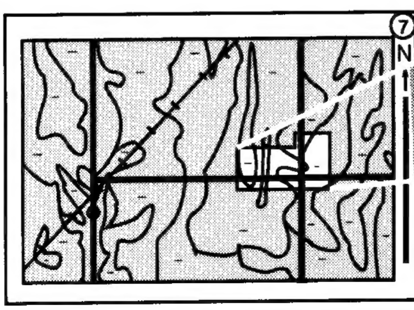


INDEX TO MAP SHEETS

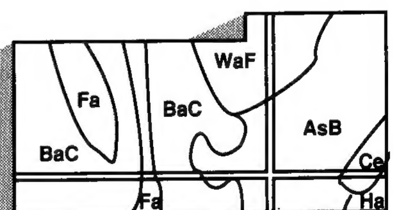


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1977-81. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Missouri Agricultural Experiment Station. The Christian County Court and private individuals provided monetary support through the Soil and Water Conservation District for maps and other assistance in the survey. It is part of the technical assistance furnished to the Christian County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Typical landscape in the Goss-Clarksville association.

Contents

Soil Series

Issued May 1985

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Christian County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the maangement needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Paul F. Larson

Paul F. Larson
State Conservationist
Soil Conservation Service

Soil Survey of Christian County, Missouri

By Jerry A. Dodd, Soil Conservation Service

Fieldwork by Jerry A. Dodd and Max W. Aldrich,
Soil Conservation Service, and J. Sybill Kizer, Forest Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with Forest Service and the
Missouri Agricultural Experiment Station

CHRISTIAN COUNTY is in southwestern Missouri (fig. 1). The northwestern part of the county is in the Ozark Border Area, and the southeastern part is in the Ozark Highland Area. The county is bordered on the north and northwest by Greene County, on the northeast by Webster County, on the east by Douglas County, on the south by Taney County, on the southwest by Stone County, and on the west by Lawrence County.

In 1980 according to the census, the county had a population of 22,401, a 32 percent increase from the 1970 census. Ozark, the county seat, has a population of 2,974. The county has a total area of 361,005 acres or 564.07 square miles.

Farming is the main enterprise in Christian County. Grass for pasture and hay is the main crop, and raising cattle and dairying are the main livestock enterprises. The southeastern part of the county is extensively forested, and about 91,000 acres is included in the Mark Twain National Forest. Of the 91,000 acres, 50,535 acres is federally administered by the Ava Ranger District, which is headquartered at Ava in Christian County.

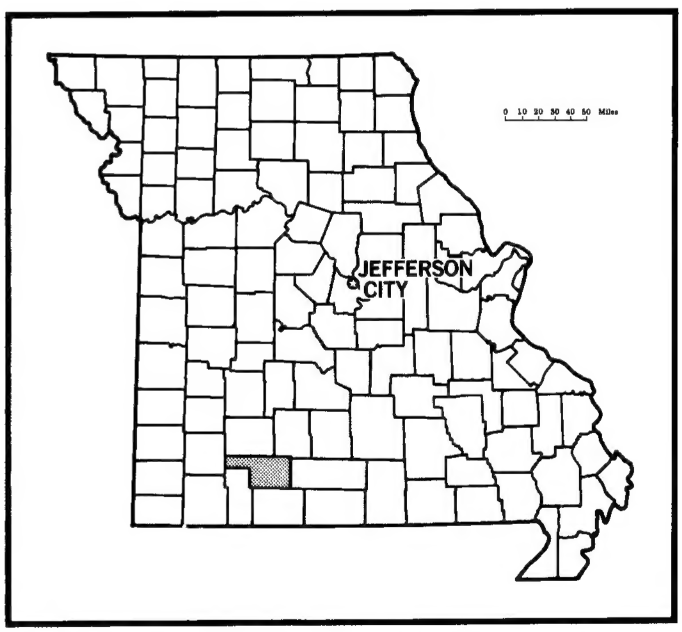


Figure 1.—Location of Christian County in Missouri.

General Nature of the Survey Area

This section provides information about the climate in Christian County.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Christian County is hot in summer, especially at the lower elevations. It is moderately cool in winter, especially at higher elevations. Rainfall is fairly heavy and well distributed throughout the year. Snow falls nearly every winter, but the snow lasts only a few days.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Springfield, Missouri, in the period 1951 to 1979. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 34 degrees F, and the average daily minimum temperature is 24 degrees. The lowest temperature on record, which occurred at Springfield on February 9, 1979, is -17 degrees. In summer the average temperature is 76 degrees, and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 113 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 39.9 inches. Of this, 24 inches, or 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.82 inches at Springfield on June 9, 1975. Thunderstorms occur on about 58 days each year, and most occur in summer.

The average seasonal snowfall is 17 inches. The greatest snow depth at any one time during the period of record was 17 inches.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 13 miles per hour, late in winter and early in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another resulting in gradual changes in characteristics. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils

under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most included soils have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other included soils, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few included soils may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of included soils in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation to precisely define and locate the soil is needed to plan for intensive uses in small areas.

The section survey procedure explains specific procedures used to make this survey.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other associations but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one soil association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Descriptions of the general soil map units follow.

1. Goss-Clarksville association

Deep, well drained and somewhat excessively drained, gently sloping to steep soils formed in cherty residuum from limestone

Landscapes in this association consist of ridgetops and side slopes on uplands; relatively narrow flood plains and terraces; stony side slopes and rock escarpments adjacent to the flood plains; and terraces and scattered areas of Rock outcrop and sinkholes.

This association makes up about 26 percent of the survey area. Goss soils make up about 78 percent of the association, Clarksville soils about 12 percent, and soils of minor extent about 10 percent (fig. 2).

The Goss soils are on side slopes and ridgetops. Typically, the surface layer is dark brown, very friable cherty silt loam about 6 inches thick. The subsoil to a depth of 62 inches or more is brown, friable cherty silty clay loam and yellowish red, firm very cherty silty clay loam in the upper part; red, mottled, firm very cherty silty clay in the middle part; and dark reddish brown, very firm cherty clay in the lower part.

The Clarksville soils are on side slopes. Typically, the surface layer is dark grayish brown, very friable very cherty silt loam about 2 inches thick. The subsurface layer is pale brown and yellowish brown, friable very cherty silt loam about 10 inches thick. The subsoil to a depth of 60 inches or more is brown, friable very cherty silt loam in the upper part; strong brown, friable extremely cherty silty clay loam in the next part; multicolored, firm, extremely cherty silty clay loam below that; and multicolored, firm, extremely cherty clay and very cherty clay in the lower part.

Of minor extent in this association are the Cedargap and Secesh soils on flood plains of small streams, the Wilderness soils on ridgetops, and the shallow Gasconade soils on rough, broken side slopes and ridgetop knobs of uplands. The Wilderness soils have a fragipan.

About 85 percent of this association has been cleared. Most of the cleared areas are used for pasture and hay. Some small grains and row crops are grown in small patches on ridgetops, low terraces, and bottom lands. The uncleared acreage is usually rough and steep. These areas are in mixed second-growth hardwoods. (A typical landscape is shown on the cover.)

The Goss and Clarksville soils are suited to grasses and legumes for pasturing beef and dairy cattle. Raising beef cattle and dairying are the main farm enterprises in this association. Slope, overgrazing, and the hazard of erosion are the main management concerns. In some areas ponds are constructed to provide water for livestock. Because permeability is moderate and moderately rapid in these soils, chemical treatment and compaction are commonly needed to enable the ponds to hold water.

The soils in this association are suited to trees. Mixed hardwoods are dominant. Steepness of slope and the hazard of erosion are the main management concerns.

The soils in this association are suitable for onsite waste disposal and building site development. Slope and large stones are the main concerns. Pollution of ground water by waste disposal facilities is a possibility, especially in areas that have sinkholes.

2. Tonti-Wilderness association

Deep, moderately well drained, gently sloping and moderately sloping soils formed in loess or other silty material and cherty residuum from limestone

Landscapes in this association consist of broad ridgetops and side slopes on uplands, a few narrow flood plains, and some sinkholes.

This association makes up about 19.5 percent of the survey area. Tonti soils and similar soils make up about

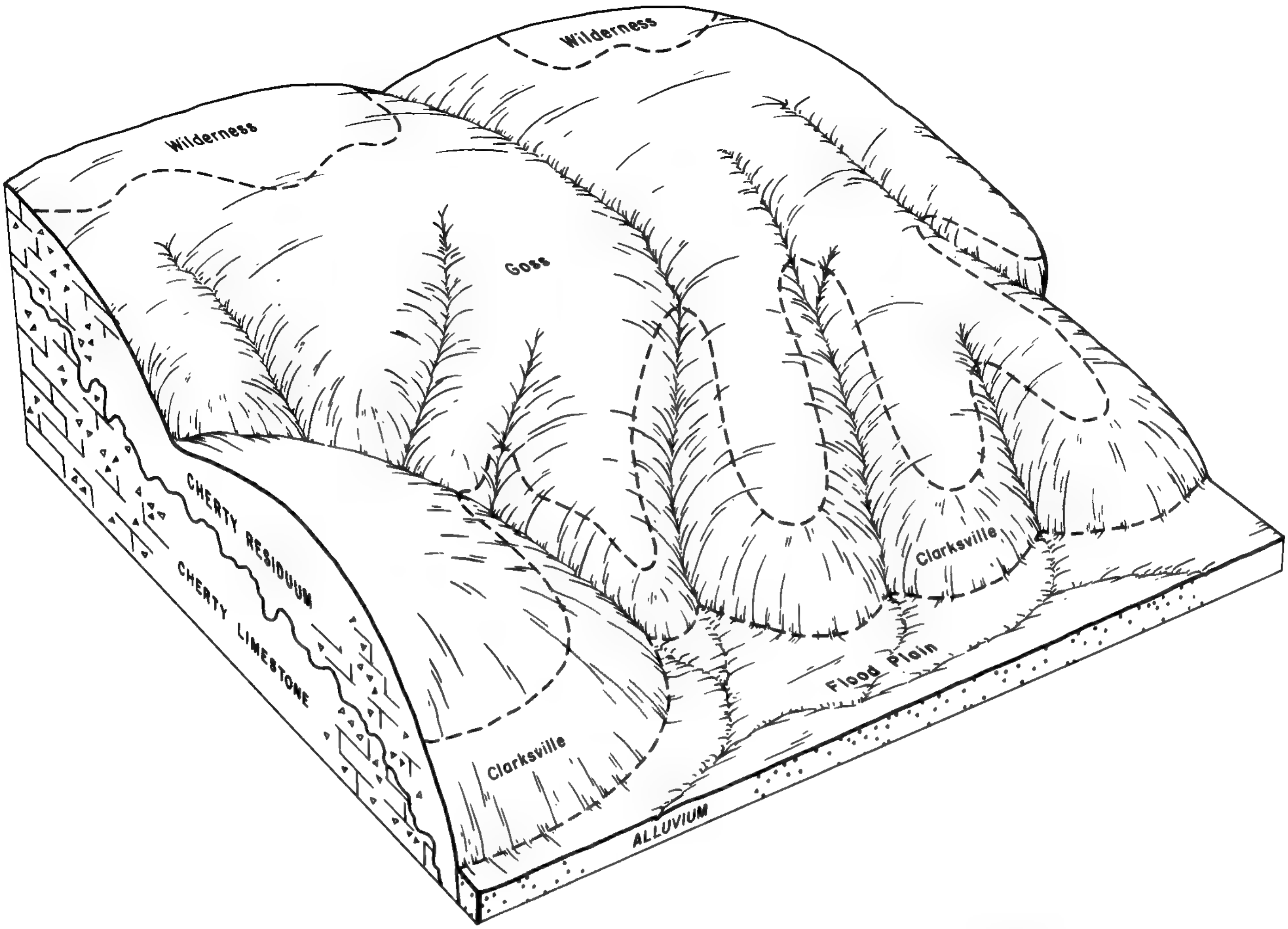


Figure 2.—Typical pattern of soils and parent material in the Goss-Clarksville association.

49 percent of the association, Wilderness soils about 41 percent, and soils of minor extent about 10 percent (fig. 3).

The gently sloping Tonti soils are on ridgetops, foot slopes, and high terraces. Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil above the fragipan is about 15 inches thick. The upper part is yellowish brown, friable silt loam; the middle part is brown, friable silty clay loam; and the lower part is yellowish brown and strong brown, mottled, friable cherty silty clay loam. The fragipan is multicolored, firm, brittle very cherty silty clay loam about 18 inches thick. The subsoil below the fragipan is red, mottled, firm extremely cherty clay to a depth of 62 inches or more.

The gently sloping and moderately sloping Wilderness soils are on the sides of ridges and on ridgetops. Typically, the surface layer is dark grayish brown, very friable cherty silt loam about 1 inch thick. The subsurface layer is brown, very friable cherty silt loam about 4 inches thick. The subsoil above the fragipan is about 11 inches thick. The upper part is yellowish brown, friable cherty silty clay loam, and the lower part is brown, mottled, firm extremely cherty silty clay loam. The fragipan is about 15 inches thick. It is multicolored, very firm, brittle extremely cherty silt loam in the upper part and very firm, brittle extremely cherty silty clay loam in the lower part. The subsoil below the fragipan is red and dark red, mottled, firm very cherty silty clay and very cherty clay to a depth of 60 inches or more.

Of minor extent in this association are the noncherty Captina and Needleye soils on broad ridgetops, the well drained Goss soils on side slopes and ridgetops, and the

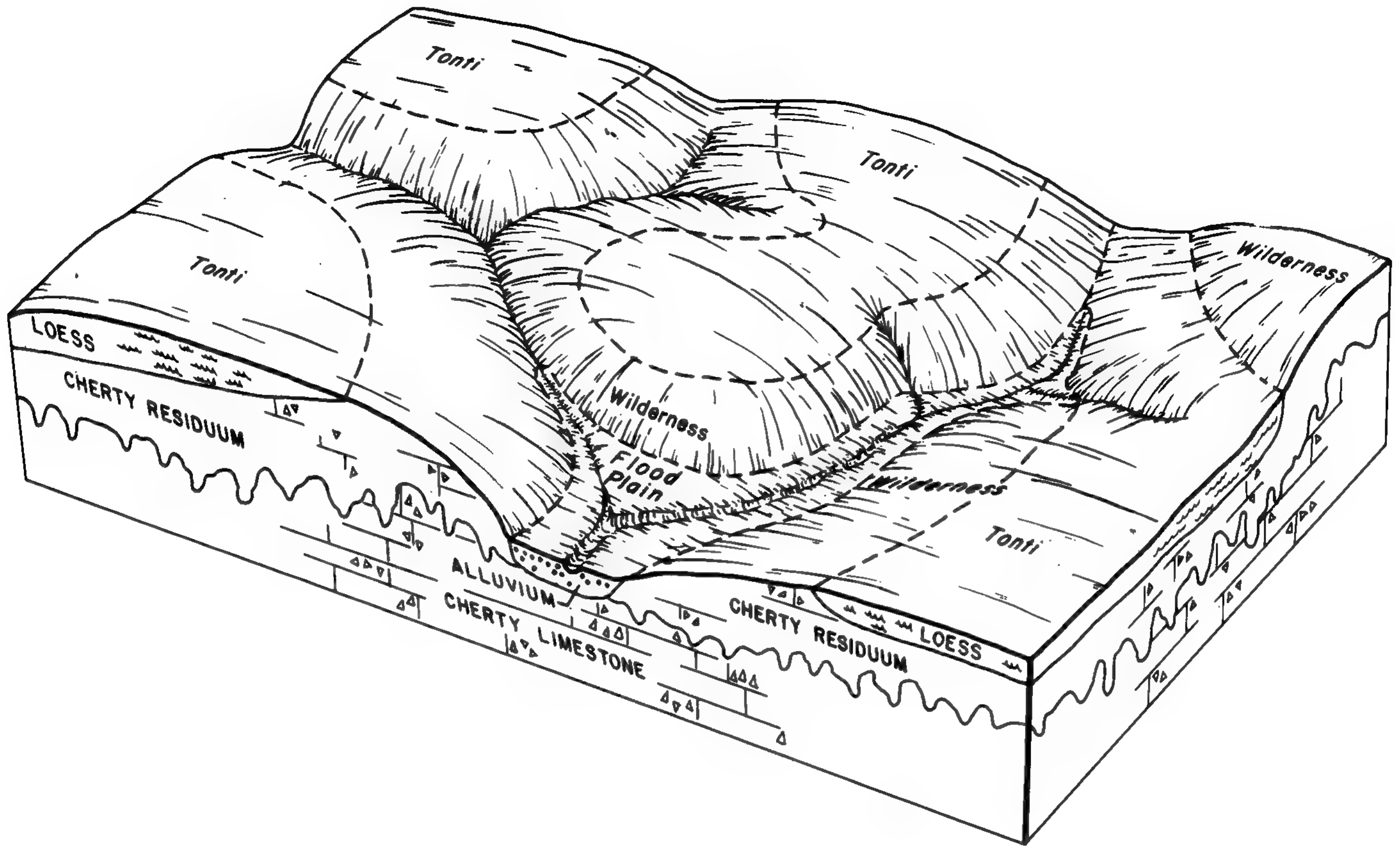


Figure 3.—Typical pattern of soils and parent material in the Tonti-Wilderness association.

well drained Cedargap soils on flood plains of narrow bottoms.

About 90 percent of this association is used for pasture and hay. Most of the rest of the acreage is in small grains, row crops, and second-growth hardwoods.

The Tonti and Wilderness soils are suited to grasses and legumes for pasturing dairy and beef cattle. Raising beef cattle and dairying are the main farm enterprises in this association. About one-half of the acreage is suited to small grain production. Overgrazing and the hazard of erosion are the main management concerns. Permeability is moderate in the subsoil below the fragipan in these soils. If ponds are constructed in this soil material, chemical treatment and compaction are commonly needed to enable the ponds to hold water.

The soils in this association are suitable for sewage lagoon waste disposal and building site development. The major soils generally are unsuitable for septic tank absorption fields. Seasonal wetness and slow permeability in the fragipan are the main concerns.

3. Bolivar association

Moderately deep, well drained, gently sloping to strongly sloping soils formed in residuum from sandstone and shale

Landscapes in this association consist of somewhat broken, nonstony and stony ridges on uplands, scattered areas of Rock outcrop, a few narrow flood plains and terraces, and rock escarpments at the upland edge of the flood plains.

This association makes up about 1 percent of the survey area. It is about 75 percent Bolivar soils and 25 percent soils of minor extent (fig. 4).

The Bolivar soils are on ridgetops, side slopes, and foot slopes. Typically, the surface layer is brown, very friable fine sandy loam about 8 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown, friable loam; the middle part is yellowish red, friable sandy clay loam; and the lower part is strong

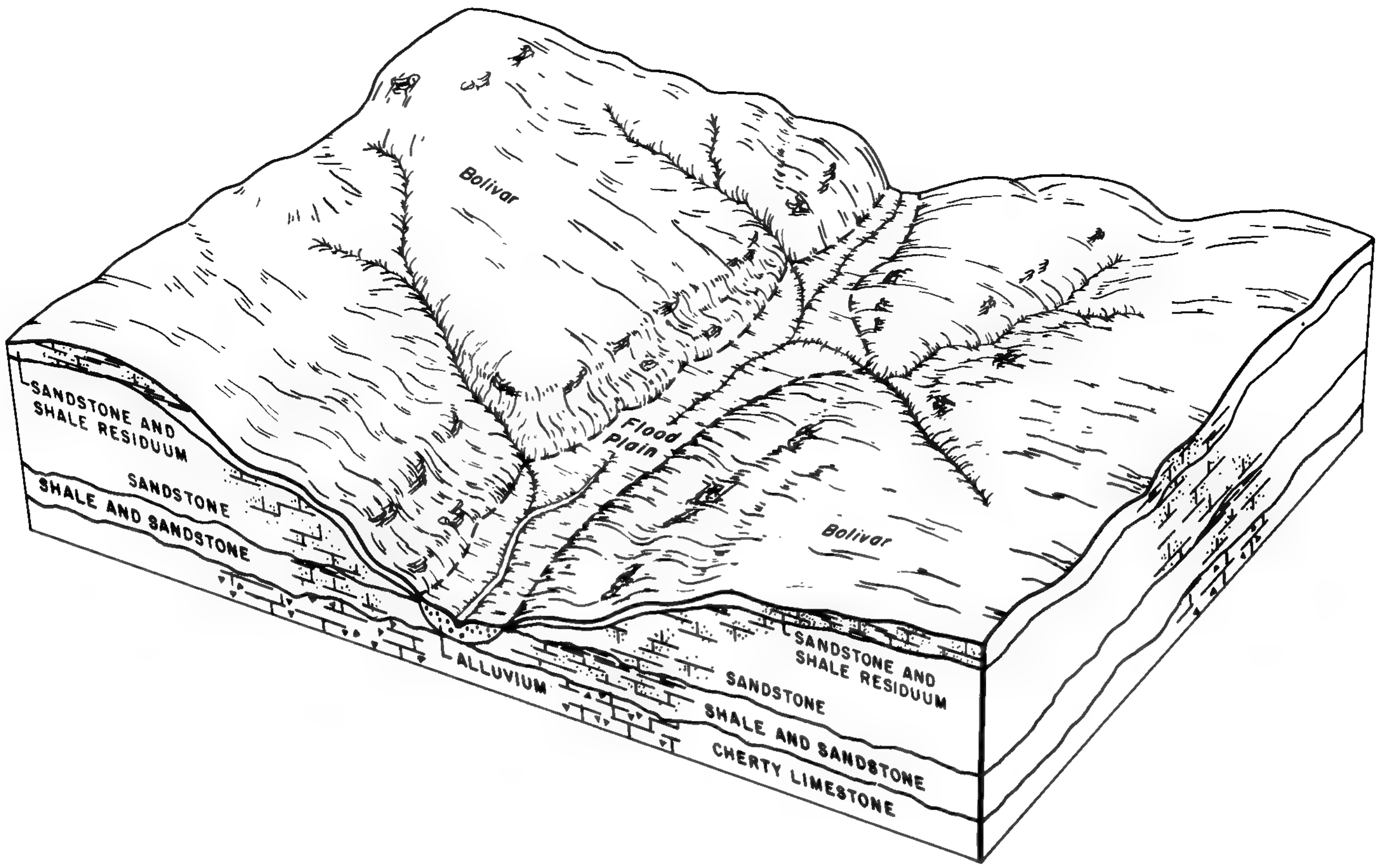


Figure 4.—Typical pattern of soils and parent material in the Bolivar association.

brown, mottled, firm channery sandy clay loam. Soft weathered sandstone is at a depth of about 33 inches.

Of minor extent in this association are the deep Cedargap soils on flood plains of narrow bottoms; the deep, moderately well drained Tonti soils on ridgetops and terraces; the deep, moderately well drained Wilderness soils on ridgetops and side slopes; and the deep, cherty Goss soils on ridgetops and side slopes.

About 70 percent of this association has been cleared. Most of the cleared areas are used for pasture. Hay, small grains, and row crops are grown in small patches in some areas. The uncleared acreage consists of stony areas and Rock outcrop. These areas are in poor quality hardwoods.

The Bolivar soils are suited to grasses and legumes for pasturing beef cattle. Raising beef cattle is the main farm enterprise in this association. Droughtiness, overgrazing, and the hazard of erosion are the management concerns.

The areas of Bolivar soils that do not have surface stones are suitable for waste disposal and building site development. Moderate depth to bedrock and the shrink-swell potential are the main concerns. Stoniness and Rock outcrop are concerns in some small areas.

4. Creldon association

Deep, moderately well drained, gently sloping soils formed in loess or other silty material and cherty residuum from limestone

Landscapes in this association consist of broad ridgetops on uplands and a few narrow flood plains.

This association makes up about one-half of one percent of the survey area. It is about 75 percent Creldon soils and about 25 percent soils of minor extent.

The Creldon soils are on ridgetops. Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil above the fragipan is about 17 inches thick. The upper part is dark brown, friable silty clay loam; the middle part is dark yellowish brown, mottled, firm silty clay loam; and the lower part is multicolored, firm silty clay. The fragipan is multicolored,

Figure 5.—Typical landscape in the Creldon association.

very firm, brittle silty clay loam and very cherty silty clay loam about 20 inches thick. The subsoil below the fragipan is dark red, mottled, very firm cherty clay to a depth of 61 inches or more.

Of minor extent in this association are the light colored Tonti soils on ridgetops and the light colored, cherty Wilderness soils on side slopes and ridgetops.

About 75 percent of this association is used for pasture and hay (fig. 5). Most of the rest of the acreage is in small grains and row crops.

The Creldon soils are suited to grasses and legumes for pasturing dairy cattle. Raising dairy cattle is the main farm enterprise in this association. These soils are also suited to small grains and row crops. Overgrazing and the hazard of erosion are the main management concerns.

The soils in this association are suitable for sewage lagoon waste disposal and building site development. Creldon soils generally are unsuitable for septic tank absorption fields. Seasonal wetness and slow permeability in the upper part of the subsoil and in the fragipan are the main concerns.

5. Peridge-Huntington association

Deep, well drained, gently sloping and nearly level soils formed in alluvium or loess and in the underlying residuum from limestone or dolomite

Landscapes in this association consist of wide flood plains and high terraces along the James River and Finley Creek.

This association makes up about 4.5 percent of the survey area. Peridge soils make up about 48 percent of the association, Huntington soils 47 percent, and soils of minor extent 5 percent (fig. 6).

The Peridge soils are on terraces. Typically, the surface layer is brown, very friable silt loam about 5 inches thick. The subsoil to a depth of 64 inches or more is yellowish red, friable silty clay loam in the upper part; red, firm silty clay loam in the middle part; and multicolored, firm silty clay loam in the lower part.

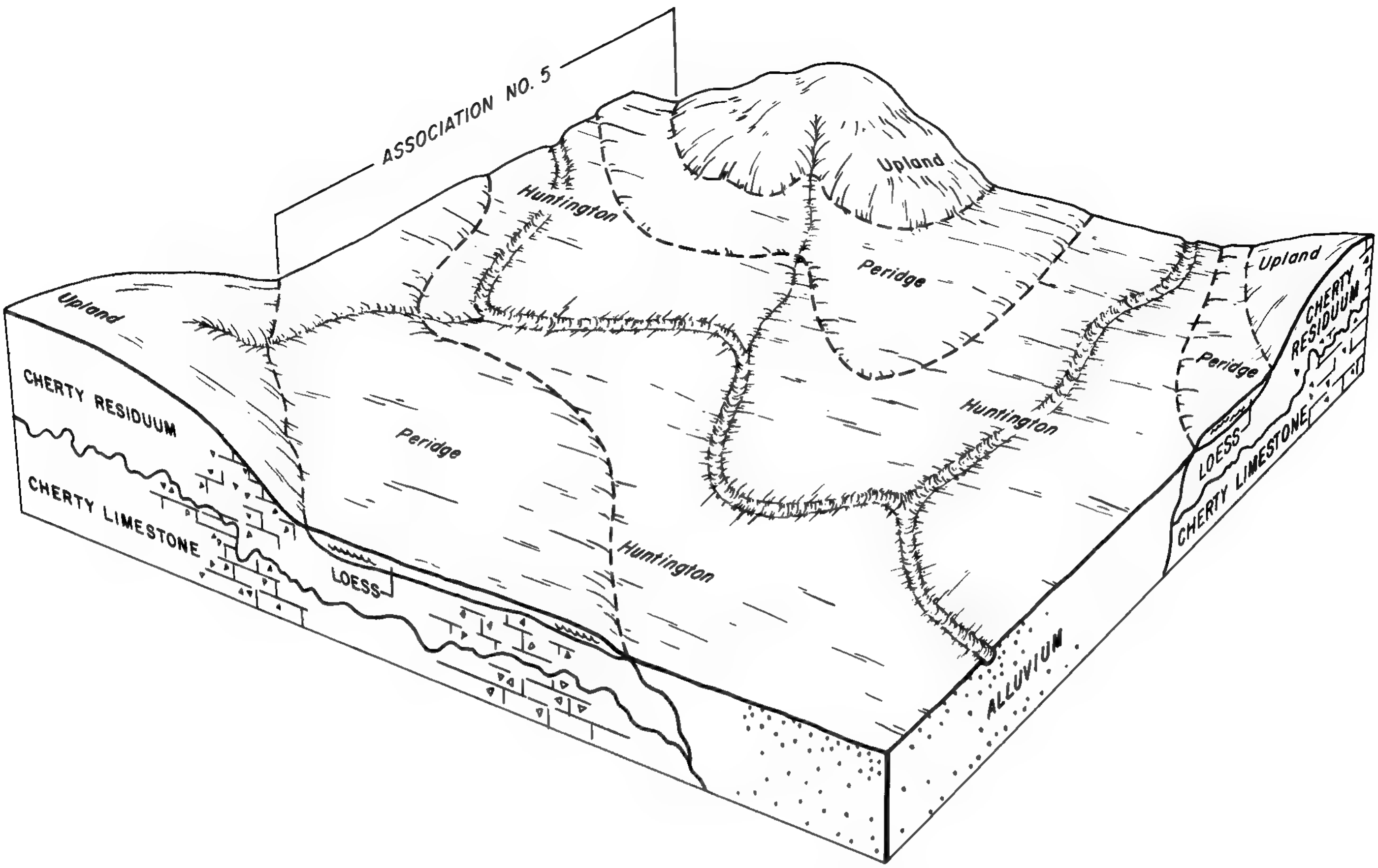


Figure 6.—Typical pattern of soils and parent material in the Peridge-Huntington association.

The Huntington soils are on flood plains. Typically, the surface layer is dark brown, very friable silt loam about 11 inches thick. The subsoil is brown, friable silt loam to a depth of 62 inches or more.

Of minor extent in this association are the Cedargap and Secesh soils. The cherty Cedargap soils are on low flood plains next to the main stream channel and along small lateral drainageways joining the main flood plain. The Secesh soils are on a higher flood plain adjacent to the upland. Secesh soils have more chert than Huntington soils.

About 85 percent of this association is used for pasture and hay. Most of the rest of the acreage is used for row crops and small grains.

The Peridge and Huntington soils are suited to row crops, small grains, grasses, legumes, and trees. The hazard of erosion on the terraces, together with occasional flooding on the major flood plains and frequent flooding on the minor flood plains, is the main management concern.

The Peridge soils are suitable for onsite waste disposal and building site development. Moderate permeability, the hazard of seepage, and slope are the main concerns for use by sanitary facilities. The Huntington soils generally are unsuitable for onsite waste disposal and building site development because of flooding.

6. Clarksville-Doniphan association

Deep, somewhat excessively drained and well drained, gently sloping to very steep soils formed in cherty and clayey residuum from limestone and shale

Landscapes in this association consist of ridgetops and side slopes on uplands, limestone escarpments on the lower part of the slopes on uplands, and narrow flood plains.

This association makes up about 22.5 percent of the survey area. Clarksville soils make up about 68 percent of the association, Doniphan soils about 31 percent, and soils of minor extent about 1 percent (fig. 7).

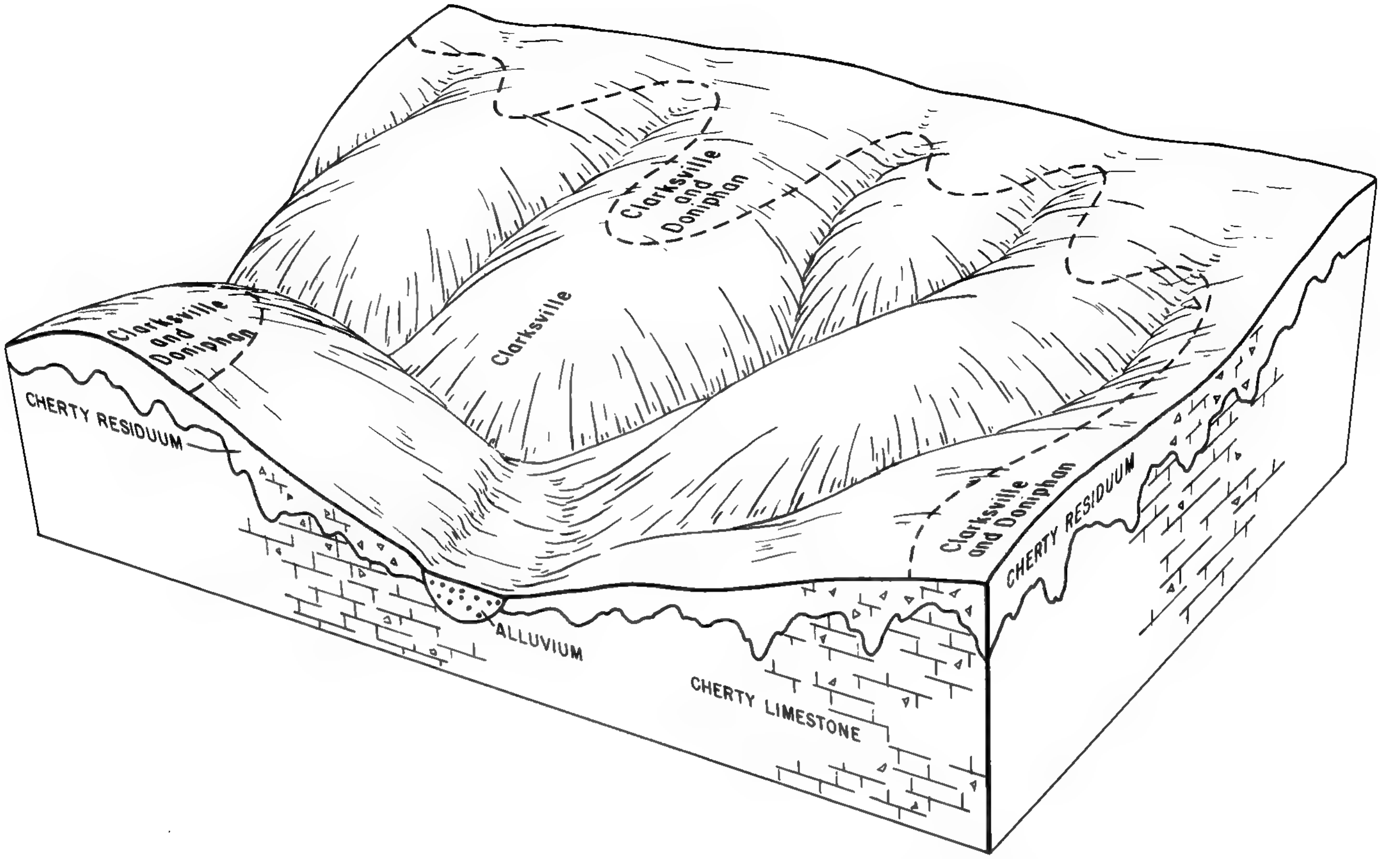


Figure 7.—Typical pattern of soils and parent material in the Clarksville-Doniphan association.

The Clarksville soils are on side slopes, narrow ridgetops, and ends of ridges. Typically, the surface layer is dark grayish brown, very friable very cherty silt loam about 4 inches thick. The subsurface layer is grayish brown, pale brown, and light yellowish brown, friable very cherty silt loam and extremely cherty silt loam about 28 inches thick. The subsoil to a depth of 60 inches or more is multicolored, friable extremely cherty silt loam in the upper part and multicolored, firm very cherty clay in the lower part.

The Doniphan soils are on ridgetops and side slopes. Typically, the surface layer is dark grayish brown, very friable cherty silt loam about 3 inches thick. The subsurface layer is pale brown and light yellowish brown, friable cherty silt loam about 4 inches thick. The subsoil to a depth of 60 inches or more is multicolored, friable cherty silty clay loam and cherty silt loam in the upper part; red and dark red, mottled, firm clay in the middle part; and multicolored, firm clay in the lower part.

Of minor extent in this association are the Cedargap soils on flood plains of small streams and the Wilderness soils on ridgetops. The Wilderness soils have a fragipan.

About 35 percent of this association has been cleared. Most of the cleared areas are used for pasture and hay. Some small grains and row crops are grown in small patches on ridgetops. The uncleared areas are in mixed, second-growth hardwoods and shortleaf pine.

The Clarksville and Doniphan soils that have been cleared are suited to grasses and legumes for pasturing beef cattle. Raising beef cattle is the main farm enterprise in this association. Overgrazing, slope, and the hazard of erosion are the main management concerns. In some areas ponds are constructed to provide water for livestock. Because permeability is moderate and moderately rapid in these soils, chemical treatment and compaction are commonly needed to enable the ponds to hold water.

A large part of this association is within the boundaries of a national forest. The soils are suited to trees and are managed for timber production. Fire prevention, the hazard of erosion, limited use of equipment, seedling mortality, and windthrow are the main management concerns. Public recreation, such as camping, hunting, hiking, and dirt bike riding, is permitted on areas

managed by the national forest. Erosion caused by dirt bikes is the main management concern.

Most of the soils in this association generally are unsuitable for onsite waste disposal and building site development because of slope. Doniphan soils and some areas of Clarksville soils are best suited to building sites and onsite waste disposal. Moderate permeability and shrink-swell potential are the main concerns on the Doniphan soils. Seepage and slope are the main concerns on the Clarksville soils.

7. Gatewood-Ocie-Gasconade association

Deep to shallow, moderately well drained and somewhat excessively drained, gently sloping to very steep soils formed in residuum from dolomite or limestone

Landscapes in this association consist of ridgetops, side slopes, benches, and knobs on uplands. In many places the side slopes are benched or stairstepped as a result of the numerous outcroppings of bedrock in the area. Glade areas are also very common. Some areas are stony. The flood plains, foot slopes, and terraces are moderately narrow to narrow.

This association makes up about 26 percent of the survey area. Gatewood soils make up about 41 percent of the association, Ocie soils about 30 percent, Gasconade soils about 16 percent, and soils of minor extent about 13 percent (fig. 8).

The Gatewood soils are on ridgetops and side slopes. Typically, the surface layer is dark grayish brown, friable cherty silt loam about 2 inches thick. The subsurface layer is brown, friable very cherty silt loam about 4 inches thick. The subsoil is about 29 inches thick. It is strong brown and yellowish brown, firm and very firm clay in the upper part and multicolored, very firm channery clay in the lower part. Hard dolomite is at a depth of about 35 inches.

The Ocie soils are on ridgetops, side slopes, and benches. Typically, the surface layer is dark grayish brown, very friable cherty silt loam about 5 inches thick. The subsurface layer is pale brown, friable cherty silt loam about 6 inches thick. The subsoil is about 45 inches thick. It is light yellowish brown and reddish yellow, friable very cherty silt loam in the upper part; light yellowish brown, mottled, friable cherty clay loam in the next part; strong brown and yellowish brown, mottled, firm cherty clay below that; strong brown, mottled, firm cherty clay in the next part; and multicolored, very firm clay in the lower part. Hard dolomite is at a depth of about 56 inches.

The Gasconade soils are on rough, broken side slopes and knobs. Typically, the surface layer is very dark brown, firm flaggy silty clay about 10 inches thick. The subsoil is very dark grayish brown, firm flaggy silty clay about 7 inches thick. Hard dolomite is at a depth of about 17 inches.

Of minor extent in this association are the moderately deep, well drained Bardley soils on ridgetops and side slopes, the somewhat excessively drained Clarksville soils on slopes at a higher elevation, and the Cedargap and Secesh soils on moderately narrow to narrow flood plains of small streams.

About 50 percent of this association has been cleared. The cleared areas are used for pasture. The uncleared areas are in mixed hardwoods ranging from scrub trees to good quality trees (fig. 9).

A large part of this association is within the boundaries of a national forest. This area is managed for timber production and also is used for recreational purposes. The Gatewood and Gasconade soils and similar soils of minor extent are poorly suited to mixed hardwoods, but the Ocie soils and similar soils of minor extent on north- and east-facing slopes and some benches are suited to mixed hardwoods. Soil depth, the hazard of erosion, Rock outcrop, and stony areas are the main management concerns.

The Gatewood, Ocie, and Gasconade soils are suited to grasses and legumes for pasturing beef cattle. Raising beef cattle is the main farm enterprise in this association. Droughtiness, overgrazing, slope, Rock outcrop, stony areas, and the hazard of erosion are the main management concerns. In some areas, ponds are constructed to provide water for livestock. Ponds placed in suitable sites usually hold water because of the expanding characteristics of the clay soils in this association.

Most of the soils in this association generally are unsuitable for onsite waste disposal and building site development. Slope, the high shrink-swell potential, Rock outcrop, depth to bedrock, stoniness, and seasonal wetness are management concerns.

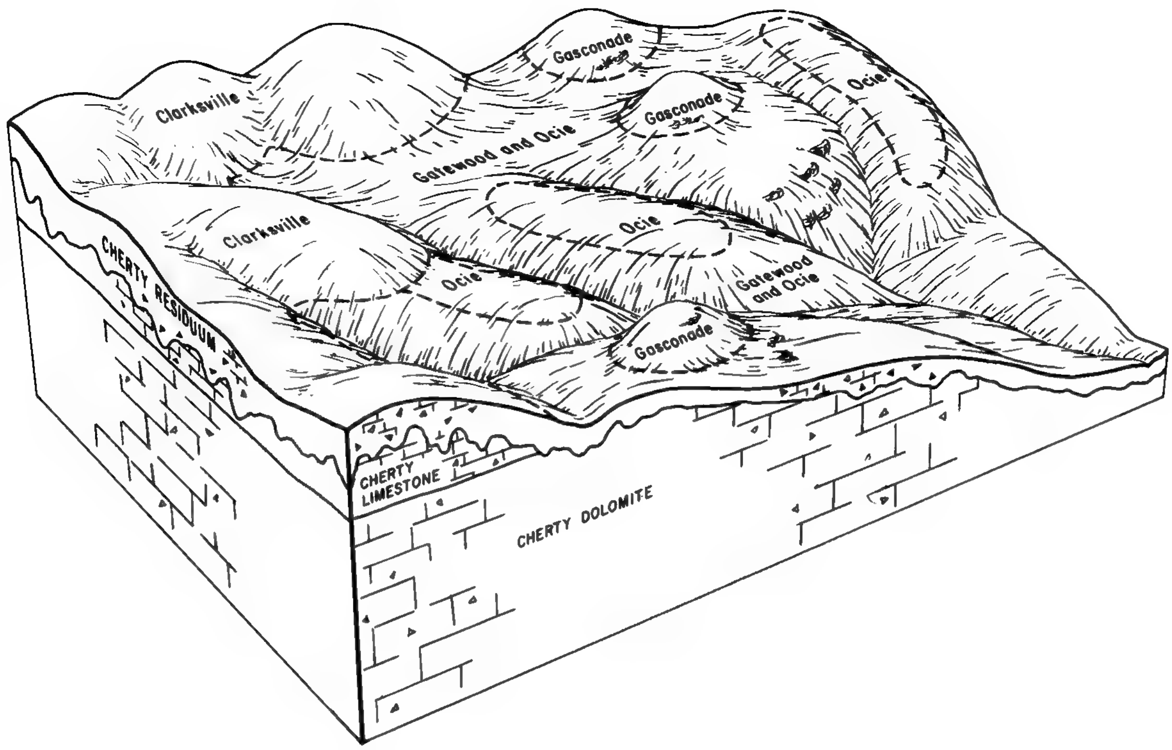


Figure 8.—Typical pattern of soils and parent material in the Gatewood-Ocie-Gasconade association.

Figure 9.—Typical landscape in the Gatewood-Ocie-Gasconade association.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Clarksville very cherty silt loam, 5 to 14 percent slopes, is one of several phases in the Clarksville series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Ocie-Bardley-Gatewood complex, 2 to 14 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits-Dumps complex is an example. Miscellaneous areas are shown on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Descriptions of the detailed soil map units follow.

5C—Wilderness cherty silt loam, 2 to 9 percent slopes. This deep, gently sloping and moderately sloping, moderately well drained soil is on ridges on uplands. Individual areas are irregular in shape and range from about 5 acres to more than 900 acres.

Typically, the surface layer is dark grayish brown, very friable cherty silt loam about 1 inch thick. The subsurface layer is brown, very friable cherty silt loam about 4 inches thick. The subsoil above the fragipan is about 11 inches thick. The upper part is yellowish brown, friable cherty silty clay loam, and the lower part is brown, mottled, firm extremely cherty silty clay loam. The fragipan is about 15 inches thick. It is multicolored, very firm, brittle, extremely cherty silt loam in the upper part and very firm, brittle, extremely cherty silty clay loam in the lower part. The subsoil below the fragipan is red and dark red, mottled, firm very cherty silty clay and very cherty clay to a depth of 60 inches or more. Some small areas are strongly sloping.

Included with this soil in mapping and making up about 10 to 15 percent of the map unit are areas of Goss and Tonti soils. The well drained Goss soils do not have a fragipan and are downslope. Tonti soils have less chert and are upslope from Wilderness soils.

Permeability is moderate above the fragipan and slow in the fragipan in this Wilderness soil. Surface runoff is medium. The available water capacity is low. A perched water table is at a depth of 1 foot to 2 feet from December to March in most years. The subsoil ranges from very strongly acid to medium acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is moderate in the subsoil below the fragipan. Rooting depth is

restricted by the fragipan between depths of 15 and 29 inches.

Most areas of this soil have been cleared and are used for hay and pasture. Some areas are used as woodland. A few areas are used for row crops.

This soil is moderately suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for hay and pasture is an effective means of controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is moderately well suited to trees. A few areas remain in native hardwoods. Seedling mortality and the hazard of windthrow are limitations, but they can be overcome by planting special stock of larger size than usual and by lighter, less intensive, more frequent thinnings to reduce stand density.

This soil is moderately suited to small grains. It is poorly suited to row crops. If this soil is used for intertilled row crops, the hazard of erosion is severe. Conservation tillage, winter cover crops, terraces and contour farming where the slopes are long enough and smooth enough, and grassed waterways help to prevent excessive soil loss. Returning crop residue or regularly adding other organic material helps to improve the fertility and increase water infiltration.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand or gravel to prevent damage caused by shrinking and swelling of the soil. Tile drains can be installed around footings to prevent damage caused by seasonal wetness. This soil generally is unsuitable for septic tank filter fields because of slow permeability and seasonal wetness. Sewage lagoon sites may need to be leveled to modify the slope, but they should function adequately if properly designed and constructed. This soil is suitable for local roads and streets, but seasonal wetness and frost action are limitations. Providing adequate side ditches and culverts helps to prevent damage caused by wetness and frost action.

This Wilderness soil is in capability subclass IVs and woodland suitability subclass 4d.

6B—Creldon silt loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is on broad ridgetops on uplands. Individual areas are irregular in shape and range from about 35 acres to more than 500 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil above the fragipan is about 17 inches thick. The upper part is dark brown, friable silty clay loam; the middle part is dark yellowish brown, mottled, firm silty clay loam; and the lower part is multicolored, firm silty clay. The fragipan is multicolored, very firm, brittle silty clay loam and very cherty silty clay loam about 20 inches thick. The subsoil below the fragipan is dark red, mottled, very firm very cherty clay to a depth of 61 inches or more. In places the surface layer is dark grayish brown and the subsoil above the fragipan contains less clay. In other places the subsoil above the fragipan contains sand and chert and the surface layer is lighter colored. Some small areas are moderately sloping.

Included with this soil in mapping and making up about 5 to 10 percent of the map unit are areas of cherty Wilderness soils and other dark cherty soils downslope from Creldon soils. Also included are areas of somewhat poorly drained soils in depressions on broad ridgetops.

Permeability is moderate above the fragipan and slow in the fragipan in this Creldon soil. Surface runoff is medium. The available water capacity is moderate. A perched water table is at a depth of 1.5 to 3 feet from December to April in most years. The subsoil ranges from slightly acid to extremely acid. The natural fertility is medium. The organic matter content is moderately low or moderate. The shrink-swell potential is moderate in the subsoil below the fragipan. Rooting depth is restricted by the fragipan between depths of 18 and 36 inches.

Most areas of this soil are used for hay and pasture. Some areas are used for row crops. This soil is well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for hay and pasture is an effective means of controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is well suited to row crops and small grains (fig. 10). If the soil is used for intertilled row crops, the hazard of erosion is severe. Conservation tillage, winter cover crops, terraces and contour farming where the slopes are long enough and smooth enough, and grassed waterways help to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand or gravel to prevent damage caused by shrinking and swelling of the soil. Tile drains can be installed around footings to prevent damage caused by seasonal wetness. This soil generally is unsuitable for septic tank filter fields because of slow permeability and seasonal wetness. Sewage lagoon sites may need to be leveled to modify the slope, but they should function adequately if properly designed and constructed. This soil is suitable

Figure 10.—Wheat on Creldon silt loam, 1 to 4 percent slopes.

for local roads and streets, but low strength, seasonal wetness, and frost action are limitations. Using crushed rock or other suitable base material helps to prevent damage caused by low strength. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by wetness and frost action.

This Creldon soil is in capability subclass IIe. It is not assigned to a woodland suitability subclass.

8B—Captina-Needleye silt loams, 1 to 3 percent slopes. These deep, very gently sloping, moderately well drained soils are on broad ridgetops on uplands. The Captina soil is on the top and sides of broad ridges, and the Needleye soil is in depressed areas on the top of broad ridges. This map unit is about 60 percent Captina soil and 30 percent Needleye soil. Individual areas are irregular in shape and range from about 5 acres to more than 1,200 acres.

Typically, the Captina soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil above the fragipan is about 21 inches thick. The upper part is yellowish brown, friable and firm silty clay loam, and the lower part is multicolored, firm silty clay loam. The fragipan is multicolored, extremely firm, brittle silty clay loam about 19 inches thick. The subsoil below the fragipan is dark red and yellowish red, mottled, firm extremely cherty clay to a depth of 63 inches or more. In some areas the surface layer has more chert. Other areas are gently sloping.

Typically, the Needleye soil has a surface layer of grayish brown and dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is pale brown and light yellowish brown, friable silt loam about 3 inches

thick. The subsoil above the fragipan is about 19 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam, and the lower part is multicolored, firm silty clay loam. The fragipan is multicolored, extremely firm, brittle silty clay loam about 32 inches thick. The subsoil below the fragipan is dark red, firm very cherty clay to a depth of 70 inches or more. In places the subsoil above the fragipan is silty clay or clay.

Included with these soils in mapping and making up about 10 percent of the map unit are areas of Tonti and Wilderness soils. Tonti soils have more chert and are in positions on the landscape similar to those of the Captina and Needleye soils. Wilderness soils are cherty and are downslope or on isolated knolls. Some places are moderately sloping.

Permeability is moderate above the fragipan and slow in the fragipan in this Captina soil. Surface runoff is medium. The available water capacity is moderate. A perched water table is at a depth of 2 to 3 feet from December to April in most years. The subsoil ranges from extremely acid to slightly acid. The natural fertility is low. The organic matter content is moderately low. The shrink-swell potential is moderate in the subsoil below the fragipan. Rooting depth is restricted by the fragipan between depths of 16 and 36 inches.

Permeability is slow in the fragipan in this Needleye soil. Surface runoff is medium. The available water capacity is moderate. A perched water table is at a depth of 1.5 to 3 feet from December to April in most years. The subsoil ranges from medium acid to extremely acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is moderate in the subsoil below the fragipan. Rooting depth is restricted by the fragipan between depths of 18 and 36 inches.

Most areas of these soils are cleared and are used for hay and pasture. A few areas are used for row crops, and a few areas are in woodland. These soils are well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for hay and pasture is an effective means of controlling erosion. Overgrazing or grazing when the soils are wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and soils in good condition.

These soils are well suited to row crops and small grains. If these soils are used for intertilled row crops, the hazard of erosion is severe. Conservation tillage, winter cover crops, terraces and contour farming where the slopes are long enough and smooth enough, and grassed waterways help to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

These soils are moderately well suited to trees, and a few small areas remain in native hardwoods. Seedling mortality and the hazard of windthrow are limitations. These limitations can be overcome by planting special stock of larger size than usual and by lighter, less intensive, more frequent thinnings to reduce stand density.

These soils are suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand or gravel to prevent damage caused by shrinking and swelling of the soil. Tile drains can be installed around footings to prevent damage from seasonal wetness. These soils generally are unsuitable for septic tank filter fields because of slow permeability and seasonal wetness. Sewage lagoon sites may need to be leveled to modify the slope but should function adequately if properly designed and constructed. These soils are suitable for local roads and streets, but low strength, seasonal wetness, and frost action are limitations. Using crushed rock or other suitable material helps to prevent damage caused by low strength. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by wetness and frost action.

These Captina and Needleye soils are in capability subclass IIe and woodland suitability subclass 4d.

21B—Peridge silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on high terraces and on uplands around the heads and sides of drainageways. Individual areas are irregular in shape and range from about 10 acres to more than 500 acres.

Typically, the surface layer is brown, very friable silt loam about 5 inches thick. The subsoil extends to a depth of 64 inches or more. It is yellowish red, friable silty clay loam in the upper part; red, firm silty clay loam in the middle part; and red, yellowish red, and pale brown, mottled, firm silty clay loam in the lower part. In places the surface layer is dark brown and is 7 to 10 inches thick. In other places the upper part of the subsoil has more sand and chert. In some places the subsoil has gray mottles. Some short slopes and breaks are moderately sloping.

Included with this soil in mapping and making up about 5 to 10 percent of the map unit are areas of moderately well drained Captina, Needleye, and Tonti soils and well drained Goss soils. Captina, Needleye, and Tonti soils have fragipans and are in the flat, depressed areas, and Goss soils have more chert and clay and are on the short, steeper breaks. Also included are some areas that have short slopes and breaks that are strongly sloping and some areas that have a silty clay or clay subsoil and are moderately deep to bedrock.

Permeability is moderate in this Peridge soil. Surface runoff is medium to slow. The available water capacity is high. The subsoil ranges from medium acid to very

Figure 11.—Cattle grazing on cool-season grass on Peridge silt loam, 2 to 5 percent slopes.

strongly acid. The natural fertility is medium. The organic matter content is moderately low or moderate. The shrink-swell potential is low.

Most areas of this soil are used for hay and pasture. A few areas are used for row crops, and a few areas are in woodland. This soil is well suited to cool-season grasses (fig. 11), warm-season grasses, and legumes. Growing well managed stands of grasses and legumes is an effective means of controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is well suited to row crops and small grains. If this soil is used for intertilled row rops, the hazard of erosion is severe. Conservation tillage, winter cover crops, terraces and contour farming where the slopes are long enough and smooth enough, and grassed waterways help to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is well suited to trees, and a few small areas remain in native hardwoods. There are no limitations or hazards for planting or harvesting trees.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Septic tank filter fields should function properly if designed and constructed to compensate for the moderate permeability. This can be done by extending the length of the laterals. Sewage lagoons should be sealed with slowly permeable material to prevent seepage. Slope is a limitation on some lagoon sites, but the sites generally can be leveled. This soil is suitable for local roads and streets, but low strength and frost action are limitations. Using crushed rock or other suitable base material helps to prevent damage caused by low strength. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by frost action.

This Peridge soil is in capability subclass IIe and woodland suitability subclass 3o.

22C—Ocie cherty silt loam, 2 to 9 percent slopes. This deep, gently sloping and moderately sloping, moderately well drained soil is on ridges and benches on uplands. Individual areas are irregular in shape and range from about 5 acres to more than 90 acres.

Typically, the surface layer is dark grayish brown, very friable cherty silt loam about 5 inches thick. The subsurface layer is pale brown, friable cherty silt loam about 6 inches thick. The subsoil is about 45 inches thick. It is light yellowish brown and reddish yellow, friable very cherty silt loam in the upper part; light yellowish brown, mottled, friable cherty clay loam in the next part; strong brown and yellowish brown, mottled, firm cherty clay below that; and multicolored, very firm clay in the lower part. Hard dolomite is at a depth of about 56 inches. In a few places the subsoil has gray mottles. In some places bedrock is at a depth of more than 60 inches. A few places are strongly sloping.

Included with this soil in mapping and making up about 5 to 10 percent of the map unit are areas of moderately deep Gatewood soils. Gatewood soils are downslope from the Ocie soils.

Permeability is moderate in the upper part of the profile and slow in the lower part in this Ocie soil. Surface runoff is medium. The available water capacity is low. The subsoil ranges from slightly acid to very strongly acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is high. Rooting depth is restricted by hard dolomite bedrock between depths of 40 and 60 inches.

Most areas of this soil are in woodland. Some areas are used for hay and pasture, and a few areas are used for row crops. This soil is moderately well suited to trees, and many areas remain in native hardwoods, together with some native pine. The use of mechanical tree planting equipment and site preparation equipment is restricted because of the chert content. Planting seedlings by hand or direct seeding may be needed.

This soil is well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for pasture is an effective means of controlling erosion. Overgrazing or grazing when this soil is wet causes surface compaction and reduces the stand of grasses and legumes. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is moderately well suited to small grains but poorly suited to row crops. If this soil is used for intertilled row crops, the hazard of erosion is severe. Conservation tillage, winter cover crops, terraces and contour farming where the slopes are long enough and smooth enough, and grassed waterways help to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand or gravel to prevent damage caused by shrinking and swelling of the soil. Tile drains should be installed around footings to prevent damage caused by seasonal wetness. Rock should be excavated or dwellings designed without basements. This soil generally is unsuitable for septic tank filter fields because of slow permeability, seasonal wetness, and depth to bedrock. In some places sewage lagoon sites may need to be leveled to modify the slope. The berms of the lagoon should be built up with additional material to modify the depth to bedrock, and the bottom sealed with slowly permeable material to prevent contamination of the ground water. This soil is suitable for local roads and streets, but low strength, the high shrink-swell potential of the lower part of the subsoil, and susceptibility to frost action are limitations. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by shrinking and swelling of the soil and frost action.

This Ocie soil is in capability subclass IVs and woodland suitability subclass 4f.

23B—Bolivar fine sandy loam, 2 to 5 percent slopes. This moderately deep, gently sloping, well drained soil is on ridgetops on uplands. Individual areas are irregular in shape and range from about 20 acres to more than 800 acres.

Typically, the surface layer is brown, very friable fine sandy loam about 8 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown, friable loam; the middle part is yellowish red, friable sandy clay loam; and the lower part is strong brown, mottled, firm, channery sandy clay loam. Soft weathered sandstone is at a depth of about 33 inches. Some places are moderately sloping.

Included with this soil in mapping and making up about 10 percent of the map unit are small areas of stony Bolivar soils in lower positions on the side slopes, Tonti soils that are on similar slopes, and cherty Wilderness soils on steeper slopes. The Tonti and Wilderness soils have fragipans.

Permeability is moderate in this Bolivar soil. Surface runoff is medium. The available water capacity is low. The subsoil ranges from very strongly acid to medium acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is moderate. The root zone is restricted by weathered sandstone between depths of 20 and 40

inches. The surface layer is very friable and is easy to till.

Most areas of this soil have been cleared and are used for hay and pasture. A few areas are used for row crops or are in woodland. This soil is well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for pasture is an effective means of controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is moderately well suited to row crops and small grains. If this soil is used for intertilled row crops, the hazard of erosion is severe. Conservation tillage, winter cover crops, terraces and contour farming where the slopes are long enough and smooth enough, and grassed waterways help to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility.

This soil is moderately well suited to trees. A few areas remain in native hardwoods. There are no limitations or hazards for planting or harvesting trees.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand or gravel to prevent damage caused by shrinking and swelling of the soil. Rock should be excavated or dwellings designed without basements. Mounding or raising the site of the absorption field with suitable fill material reduces the likelihood of polluting the ground water. The berms of lagoons should be built up with additional material to modify the depth to bedrock and the bottom sealed with slowly permeable material to overcome seepage. This soil is suitable for local roads and streets, but low strength, shrinking and swelling of the subsoil, and frost action are limitations. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by shrinking and swelling of the soil.

This Bolivar soil is in capability subclass IIIe and woodland suitability subclass 4o.

24F—Gatewood-Ocie-Rock outcrop complex, 9 to 35 percent slopes. This map unit consists of strongly sloping to steep, moderately well drained soils and Rock outcrop on side slopes of ridges on uplands. The percentage of Gatewood soil, Ocie soil, and Rock outcrop varies from place to place, but averages about 40 percent Gatewood soil, 30 percent Ocie soil, and 15 percent Rock outcrop. Individual areas are irregular in shape and range from about 5 acres to more than 1,100 acres. The moderately deep Gatewood soil and the Rock outcrop generally are on south- and west-facing slopes. The deep Ocie soil is on north- and east-facing slopes.

Typically, the Gatewood soil has a surface layer of dark grayish brown, friable cherty silt loam about 2 inches thick. The subsurface layer is brown, friable very cherty silt loam about 4 inches thick. The subsoil is about 29 inches thick. It is strong brown, firm clay in the upper part; yellowish brown, very firm clay in the middle part; and multicolored, very firm channery clay in the lower part. Hard dolomite is at a depth of about 35 inches. In many places the clayey subsoil is red. Some areas are very steep.

Typically, the Ocie soil has a surface layer of brown, very friable cherty silt loam about 6 inches thick. The subsurface layer is yellowish brown, mottled, friable very cherty silt loam about 10 inches thick. The strong brown, mottled subsoil is about 32 inches thick. It is friable very cherty silty clay loam in the upper part, firm cherty silty clay in the middle part, and firm cherty clay in the lower part. Hard dolomite is at a depth of about 48 inches. Rock outcrop consists of exposures of dolomite bedrock and, in places, sandstone bedrock.

Included with the Gatewood and Ocie soils and Rock outcrop in mapping and making up about 15 percent of the map unit are areas of moderately deep, well drained Bardley soils; shallow, somewhat excessively drained Gasconade soils; shallow, well drained soils; and deep, well drained soils that are more than 60 inches thick over dolomite bedrock. The Bardley soils are on south- and west-facing slopes, and the Gasconade soils and other shallow soils are on rough breaks and knobs near the dolomite, limestone, and sandstone bedrock. The other deep soils are on north- and east-facing slopes.

Permeability is slow in this Gatewood soil. Surface runoff is rapid. The available water capacity is low. The subsoil is neutral to strongly acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is high. Rooting depth is restricted by hard dolomite bedrock between depths of 20 and 40 inches.

Permeability is moderate in the upper part of the profile and slow in the lower part in this Ocie soil. Surface runoff is rapid. The available water capacity is low. A perched water table is at a depth of 3 to 5 feet from December to April in most years. The subsoil is slightly acid to very strongly acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is high. Rooting depth is restricted by hard dolomite bedrock between depths of 40 and 60 inches.

Most areas of these soils are in poor quality to good quality woodland. Some areas are used for hay and pasture. These soils are unsuited to row crops because of steep slopes and Rock outcrop.

The Gatewood soil is poorly suited to trees, and the Ocie soil is moderately well suited to trees. Many areas remain in native hardwoods. Scrub hardwoods and

eastern redcedar are on the south- and west-facing slopes, and good quality hardwoods are on the north- and east-facing slopes. Erosion is a hazard on these soils. Careful design and construction of roads and skid trails are required to minimize the steepness and length of slope and the concentration of water. Steepness of slope limits the use of equipment, but this limitation can be overcome by placing roads and skid trails on the contour, or, where necessary, by yarding the logs uphill to logging roads and skid trails. Seeding disturbed areas may be needed after harvesting is completed. The use of tree planting equipment and site preparation equipment is restricted because of the chert content of the soils. Planting seedlings by hand or direct seeding may be necessary. Seedling mortality and the hazard of windthrow are limitations on the Gatewood soil, but these limitations can be overcome by planting stock of larger size than usual and by lighter, less intensive, and more frequent thinnings to reduce stand density.

These soils are moderately well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Using well managed grasses and legumes for pasture is an effective means of controlling erosion. Overgrazing or grazing when the soils are wet causes surface compaction and reduces the stand of grasses and legumes. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soils in good condition.

These soils generally are unsuitable for building site development and onsite waste disposal because of the high shrink-swell potential of the clayey subsoil, slope, depth to bedrock, and slow permeability.

These Gatewood and Ocie soils and Rock outcrop are in capability subclass VIIs. The Gatewood soil is in woodland suitability subclass 5c, and the Ocie soil is in woodland suitability subclass 4f.

25D—Ocie-Bardley-Gatewood complex, 2 to 14 percent slopes. This map unit consists of deep, gently sloping to strongly sloping, moderately well drained Ocie soil; moderately deep, gently sloping to strongly sloping, well drained Bardley soil; and moderately deep, gently sloping to strongly sloping, moderately well drained Gatewood soil. These soils are on ridges on uplands. The percentage of Ocie soil, Bardley soil, and Gatewood soil varies from place to place, but averages about 45 percent Ocie soil, 30 percent Bardley soil, and 15 percent Gatewood soil. Individual areas are irregular in shape and range from about 5 acres to more than 200 acres.

Typically, the Ocie soil has a surface layer of pale brown silt loam about 6 inches thick. The subsoil is about 39 inches thick. It is light yellowish brown, friable cherty and very cherty silt loam in the upper part; yellowish brown, mottled, firm cherty clay in the middle part; and multicolored, firm clay in the lower part. Hard dolomite is at a depth of about 45 inches.

Typically, the Bardley soil has a surface layer of dark grayish brown, friable very cherty silt loam about 3 inches thick. The subsoil is about 19 inches thick. It is yellowish red, firm cherty silty clay in the upper part; dark red and yellowish red, very firm clay in the middle part; and dark red and brown, very firm cherty clay in the lower part. The substratum extends to a depth of about 26 inches. It is multicolored, very firm clay and is underlain by a thin layer of weathered dolomite over hard dolomite bedrock.

Typically, the Gatewood soil has a surface layer of very dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 30 inches thick. It is yellowish brown, mottled, firm very cherty silty clay in the upper part; yellowish brown, mottled, very firm silty clay and sandy clay in the middle part; and multicolored, firm clay in the lower part. Hard dolomite is at a depth of about 34 inches.

Included with these soils in mapping and making up about 10 percent of the map unit are areas of shallow, somewhat excessively drained Gasconade soils and other shallow, well drained soils and Rock outcrop. The Gasconade soils and the other shallow soils are near rough breaks and knobs. The Rock outcrop is on the rough breaks and knobs.

Permeability is moderate in the upper part of this Ocie soil and slow in the lower part. Surface runoff is medium to rapid. The available water capacity is low. A perched water table is at a depth of 3 to 5 feet from December to April in most years. The subsoil ranges from slightly acid to very strongly acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is high. Rooting depth is restricted by hard dolomite bedrock between depths of 40 and 60 inches.

Permeability is moderate in this Bardley soil. Surface runoff is medium to rapid. The available water capacity is very low. The subsoil ranges from slightly acid to very strongly acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is high. Rooting depth is restricted by hard dolomite bedrock between depths of 20 and 40 inches.

Permeability is slow in this Gatewood soil. Surface runoff is medium to rapid. The available water capacity is low. The subsoil ranges from neutral to strongly acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is high. Rooting depth is restricted by hard dolomite bedrock between depths of 20 and 40 inches.

Most areas of these soils are in woodland. Some areas are used for hay and pasture. These soils generally are unsuited to row crops because of slope, the chert content of the soils, and Rock outcrop. The Ocie soil is moderately well suited to trees, but the Bardley and Gatewood soils are poorly suited to trees. Many areas remain in native hardwoods, together with some redcedar and native pine. Seedling mortality and

the hazard of windthrow are limitations on the Bardley and Gatewood soils, but these limitations can be overcome by planting special stock of larger size than usual and by lighter, less intensive, more frequent thinnings to reduce stand density. The use of mechanical tree planting equipment and site preparation equipment is restricted on the Bardley soil because of chert. Planting seedlings by hand or direct seeding may be necessary.

These soils are moderately well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for pasture is an effective means of controlling erosion. Overgrazing or grazing when the soils are wet causes surface compaction and reduces the stand of grasses and legumes. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soils in good condition.

These soils are suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Rock can be excavated or the dwelling designed to conform to the depth to bedrock. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand or gravel to prevent damage caused by shrinking and swelling of the soils. Tile drains installed around footings can prevent damage caused by seasonal wetness. Land shaping can be used to modify the slope, or the dwelling can be designed to complement the slope. These soils generally are unsuitable for septic tank filter fields because of depth to bedrock, the moderate to slow permeability, and seasonal wetness. In many places sewage lagoon sites may need to be leveled to modify the slope. The berms of the lagoon should be built up with additional material to modify the depth to bedrock, and the bottom sealed with slowly permeable material to prevent contamination of the ground water. A possible alternative is to pipe the sewage to adjacent areas that are more suitable for disposal facilities. This soil is suitable for local roads and streets, but low strength, high shrink-swell potential, and susceptibility to frost action are limitations. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength. Grading the road to shed water and providing adequate side ditches and culverts help to prevent damage caused by the shrinking and swelling of the soil and frost action.

These Ocie, Bardley, and Gatewood soils are in capability subclass VIs. The Ocie soil is in woodland suitability subclass 4o, and the Bardley and Gatewood soils are in woodland suitability subclass 5c.

27D—Bolivar stony fine sandy loam, 2 to 14 percent slopes. This moderately deep, gently sloping to strongly sloping, well drained soil is on sides and knobs of ridges on uplands. Individual areas are irregular in shape and range from about 75 acres to more than 110 acres. Sandstones range from 35 to about 100 feet apart on the surface throughout most parts of the map unit.

Typically, the surface layer is dark brown and brown, friable stony fine sandy loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part is strong brown, friable sandy clay loam; the middle part is brown, firm sandy clay loam; and the lower part is multicolored, firm shaly clay underlain by multicolored, weathered clayey shale and soft weathered sandstone. Hard shale and sandstone are at a depth of about 59 inches.

Included with this soil in mapping and making up as much as 10 percent of the map unit are areas of Bolivar fine sandy loam, Goss soils, Rock outcrop, and Wilderness soils. Bolivar fine sandy loam is on smooth broad ridgetops. The cherty Goss soils are on the steeper areas. Rock outcrop is on knobs on ridgetops and on side slopes. The cherty Wilderness soils are in positions on the side slopes similar to those of Bolivar stony fine sandy loam. The Wilderness soils have a fragipan.

Permeability is moderate in this Boliver soil. Surface runoff is medium to rapid. The available water capacity is low. The subsoil ranges from extremely acid to strongly acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is moderate. The root zone is limited by weathered clayey shale and sandstone bedrock between depths of 20 and 40 inches. The surface layer is stony and difficult to till in most places.

Most areas of this soil are in woodland. This soil generally is unsuited to row crops because of stoniness, Rock outcrop, and slope. It is moderately well suited to trees, and most areas have stands of native hardwoods. The use of mechanical tree planting equipment or site preparation equipment is restricted because of the stony surface layer and outcrops of rock. Planting seedlings by hand or direct seeding may be necessary.

This soil is poorly suited to cool-season grasses, warm-season grasses, and legumes; growing well managed grasses and legumes for pasture, however, is an effective means of controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil generally is unsuitable for building site development and onsite waste disposal because of depth to bedrock, the stony surface layer, and outcrops of rock.

This Bolivar soil is in capability subclass VIs and woodland suitability subclass 4x.

35D—Doniphan-Clarksville cherty silt loams, 2 to 14 percent slopes. This map unit consists of deep, gently sloping to strongly sloping soils on ridgetops and side slopes on uplands. The well drained Doniphan soil is predominantly on the ridgetops, and the somewhat excessively drained Clarksville soil is on the side slopes

at lower elevations. This map unit is about 65 percent Doniphan soil and 25 percent Clarksville soil. Individual areas are relatively long and irregular in shape and range from about 10 acres to more than 1,000 acres. Some areas have a few stones on the surface.

Typically, the Doniphan soil has a surface layer of dark grayish brown, very friable cherty silt loam about 3 inches thick. The subsurface layer is pale brown and light yellowish brown, friable cherty silt loam about 4 inches thick. The next layer is multicolored, friable cherty silty clay loam and cherty silt loam. The subsoil extends to a depth of 60 inches or more. It is red and dark red, mottled, firm clay in the upper part and multicolored, firm clay in the lower part. In some places the subsoil is cherty clay. In other places the upper part of the subsoil has less clay and more chert.

Typically, the Clarksville soil has a surface layer of brown and dark brown, very friable cherty silt loam about 5 inches thick. The subsurface layer is pale brown and light yellowish brown, mottled, friable very cherty and extremely cherty silt loam about 19 inches thick. The subsoil extends to a depth of 78 inches or more. It is strong brown, friable extremely cherty silty clay loam in the upper part; multicolored, firm very cherty silty clay in the middle part; and dark red, mottled, firm extremely cherty clay in the lower part. In some places the upper part of the subsoil is very cherty silty clay. In other places the soil is moderately steep.

Included with these soils in mapping and making up about 10 percent of the map unit are areas of moderately well drained Wilderness soils that have a fragipan. These soils are on wide areas of the ridgetops.

Permeability is moderate in this Doniphan soil. Surface runoff is medium to rapid. The available water capacity is low. The subsoil ranges from strongly acid to extremely acid. The natural fertility is low. The organic matter content is low or moderately low. The shrink-swell potential is moderate.

Permeability is moderately rapid in this Clarksville soil. Surface runoff is medium to rapid. The available water capacity is low. The subsoil ranges from strongly acid to very strongly acid. The natural fertility is low. The organic matter content is moderately low.

Most areas of these soils are in pasture and woodland. Some areas are used for hay, and a few areas are used for row crops. These soils generally are unsuited to row crops because of slope and chert content. They are moderately well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for hay and pasture is an effective means of controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soils in good condition.

These soils are moderately well suited to trees, and many areas are in native hardwoods, together with some native pine. The use of mechanical tree planting equipment and site preparation equipment is restricted because of the content of chert in the soil. Planting seedlings by hand or direct seeding may be necessary. In addition, planting stock of larger size than usual may be needed on the Clarksville soil to improve the chances of seedling survival.

These soils are suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. The main limitations of the Doniphan soil are moderate shrink-swell potential in the clay subsoil, slope, and moderate permeability. The main limitations of the Clarksville soil are seepage and slope. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand and gravel to prevent damage caused by shrinking and swelling of the Doniphan soil. Land shaping can be used to modify the slope, or dwellings should be designed to conform to the slope. Septic tank filter fields should be designed and constructed to compensate for the moderate permeability of these soils. This can be done by extending the length of the laterals and backfilling around the tile with stone-free material. Land shaping can be used to modify the slope. Sewage lagoon sites should be leveled to modify the slope and sealed with slowly permeable material to prevent seepage. An alternative is to pipe the sewage to adjacent areas that are more suitable for disposal facilities. These soils are suitable for local roads and streets, but low strength, the shrink-swell potential of the subsoil, slope, and frost action are limitations. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength. Some cutting and filling may be needed, or the road should be designed to complement the slope. Grading the road to shed water and providing adequate side ditches and culverts help to prevent damage caused by shrinking and swelling of the soil and frost action.

These Doniphan and Clarksville soils are in capability subclass VIs and woodland suitability subclass 4f.

43C—Goss cherty silt loam, 2 to 9 percent slopes. This deep, gently sloping and moderately sloping, well drained soil is on ridgetops and side slopes on uplands. Individual areas range from about 10 acres to more than 1,000 acres. Five to 10 percent coarse chert is on the surface. Sinkholes are in some places.

Typically, the surface layer is dark grayish brown, very friable cherty silt loam about 6 inches thick. The subsurface layer is brown, friable very cherty silt loam about 5 inches thick. The subsoil extends to a depth of 63 inches or more. It is strong brown, friable very cherty silty clay loam in the upper part; yellowish red, mottled, firm very cherty silty clay loam in the middle part; and red and dark red, very firm cherty silty clay and cherty clay in the lower part. In a few places the surface layer is very dark grayish brown cherty silt loam about 7 inches

thick. Some places are shallower to limestone. A few places are strongly sloping.

Included with this soil in mapping and making up as much as 10 percent of the map unit are areas of moderately well drained Wilderness soils. The Wilderness soils have fragipans and are upslope or in positions similar to those of Goss soil.

Permeability is moderate in this Goss soil. Surface runoff is medium. The available water capacity is low. The subsoil ranges from neutral to very strongly acid. The natural fertility is low. The organic matter content is moderately low. The shrink-swell potential is moderate.

Most areas of this soil have been cleared and are used for hay and pasture. A few areas are used for row crops, and a few areas are in woodland. This soil is moderately well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for pasture is an effective means of controlling erosion on this soil. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is poorly suited to row crops and small grains. If this soil is used for intertilled row crops, the hazard of erosion is severe. Conservation tillage, winter cover crops, terraces and contour farming where the slopes are long enough and smooth enough, and grassed waterways help to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility and increase water infiltration.

This soil is moderately well suited to trees. A few areas remain in native hardwoods. The use of mechanical tree planting equipment and site preparation equipment is limited because of the chert content in this soil. Planting seedlings by hand or direct seeding may be necessary.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand or gravel to prevent damage caused by the shrinking and swelling of the soil. Large stones should be removed from the building site. Septic tank filter fields should be designed and constructed to compensate for the moderate permeability and reduced volume caused by the content of chert. This can be done by extending the length of the laterals and backfilling around the tile with material free of stones. Sewage lagoons need to be sealed with slowly permeable material to prevent seepage. In addition, the sites can be leveled in those areas where slope is a limitation. This soil is suitable for local roads and streets, but low strength, high shrink-swell potential of the subsoil, and frost action are limitations. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by shrinking and swelling of the soil and frost action.

This Goss soil is in capability subclass IVs and woodland suitability subclass 4f.

43D—Goss cherty silt loam, 9 to 14 percent slopes. This deep, strongly sloping, well drained soil is on side slopes of ridges on uplands. Individual areas range from about 10 acres to more than 1,000 acres. Five to 10 percent coarse chert is on the surface. Sinkholes are in some places.

Typically, the surface layer is dark brown, very friable cherty silt loam about 6 inches thick. The subsoil extends to a depth of 62 inches or more. It is brown and yellowish red, friable and firm cherty and very cherty silty clay loam in the upper part; red, mottled, firm very cherty silty clay in the middle part; and dark reddish brown, firm cherty clay in the lower part. Some places are shallower to limestone. A few areas are moderately steep.

Included with this soil in mapping and making up as much as 15 percent of the map unit are areas of somewhat excessively drained Clarksville and Gasconade soils, Rock outcrop, and stony areas. The Clarksville soils are on steeper parts of the map unit, the shallow Gasconade soils and Rock outcrop are on rough breaks, and the stony soils are in small areas throughout. A few areas are steep.

Permeability is moderate in this Goss soil. Surface runoff is rapid. The available water capacity is low. The subsoil ranges from neutral to very strongly acid. The natural fertility is low. The organic matter content is moderately low. The shrink-swell potential is moderate.

Most areas of this soil have been cleared and are used for pasture. Some areas are used for hay, and a few areas are in woodland. This soil generally is unsuited to row crops because of the slope and high chert content. It is moderately well suited to cool-season grasses (fig. 12), warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for hay and pasture is an effective means of controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is moderately well suited to trees. A few areas remain in native hardwoods. The use of mechanical tree planting equipment and site preparation equipment is limited because of the chert content of the soil. Planting seedlings by hand or direct seeding may be necessary.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand and gravel to prevent damage caused by shrinking

Figure 12.—Cool-season grass on Goss cherty silt loam, 9 to 14 percent slopes.

and swelling of the soil. Land shaping can be used to modify the slope, or the dwelling should be designed to conform to the slope. Large stones should be removed from the building site. Septic tank filter fields should be designed and constructed to compensate for the moderate permeability and reduced volume caused by the content of chert. This can be done by extending the length of the laterals and backfilling around the tile with material free of stones. Land shaping can be used to modify the slope, or the lateral field should be designed to operate on slope. Sewage lagoon sites need to be leveled to modify the slope and sealed with slowly permeable material to prevent seepage. An alternative is to pipe the sewage to adjacent areas that are more suitable. This soil is suitable for local roads and streets, but low strength, slope, moderate shrink-swell potential, and frost action are limitations. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength. Some cutting and filling may be necessary, or the road should be designed to conform to the slope. Grading the road to shed water and providing adequate side ditches and culverts help to prevent damage caused by shrinking and swelling of the soil and frost action.

This Goss soil is in capability subclass VIs and woodland suitability subclass 4f.

44G—Goss-Gasconade complex, 2 to 50 percent slopes. This map unit consists of deep, gently sloping to moderately steep, well drained Goss soil and shallow, gently sloping to very steep, somewhat excessively drained Gasconade soil (fig. 13). The Goss soil is on ridgetops and side slopes on uplands, and the Gasconade soil is on lower side slopes on uplands adjacent to streams. This map unit is about 60 percent Goss soil and 25 percent Gasconade soil. A few scarped bluffs of exposed bedrock are adjacent to the streams. Some areas have a few stones on the surface. Individual areas are long and narrow and range from about 10 acres to more than 700 acres.

Typically, the Goss soil has a surface layer of dark brown, very friable cherty silt loam about 3 inches thick. The subsurface layer is about 12 inches thick. The upper part is brown, friable cherty silt loam, and the lower part is light yellowish brown, friable very cherty silt loam. The

Figure 13.—Landscape in Goss-Gasconade complex, 2 to 50 percent slopes.

subsoil extends to a depth of 64 inches or more. It is light yellowish brown, friable very cherty silty clay loam in the upper part; reddish brown, firm very cherty silty clay loam in the middle part; and dark red, very firm very cherty clay in the lower part.

Typically, the Gasconade soil has a surface layer of very dark brown, firm flaggy silty clay loam about 3 inches thick. The subsoil is dark brown, firm very flaggy silty clay about 14 inches thick. Hard limestone is at a depth of about 17 inches. In places the surface layer is lighter colored and the subsoil is red.

Included with these soils in mapping and making up as much as 15 percent of the map unit are areas of Rock outcrop and moderately well drained Wilderness soils. The Rock outcrop is on rough breaks. The Wilderness soils are on ridgetops and side slopes. They have a fragipan.

Permeability is moderate in this Goss soil. Surface runoff is rapid. The available water capacity is low. The subsoil ranges from neutral to very strongly acid. The natural fertility is low. The organic matter content is moderately low.

Permeability is moderately slow in this Gasconade soil. Surface runoff is rapid. The available water capacity is very low. The subsoil ranges from slightly acid to mildly alkaline. The natural fertility is medium. The organic matter content is moderate. Rooting depth is restricted by hard limestone bedrock between depths of 4 and 20 inches. The shrink-swell potential is moderate.

Most areas of these soils are in woodland. Other areas have been cleared and are used for pasture. These soils generally are unsuited to row crops because of very steep slopes, the chert or flaggy content of the soils, shallow depth to bedrock in the Gasconade soil, and Rock outcrop.

The Goss soil is moderately well suited to trees and is in native hardwoods. The Gasconade soil is poorly suited to trees and is in native eastern redcedar and scrub hardwoods. Erosion is a hazard on these soils. Careful design and construction of roads and skid trails are needed to minimize the steepness and length of slope and the concentration of water. Steepness of slopes limits the use of equipment, but this limitation can be minimized by careful design of roads and by placing roads and skid trails on the contour or, where necessary, by yarding the logs uphill to logging roads and skid trails. Seeding disturbed areas may be needed after harvesting is completed. The use of tree planting equipment and site preparation equipment is restricted because of the slope and chert content of the soils. Planting seedlings by hand or direct seeding may be necessary. Seedling mortality on both soils and the hazard of windthrow on the Gasconade soil are management concerns. Planting stock of larger size than usual helps to achieve better survival rates, and, to some extent, lighter, less intensive, more frequent thinnings to reduce stand density can overcome windthrow.

The Goss soil is moderately well suited to cool-season grasses, warm-season grasses, and some kinds of legumes, but the Gasconade soil is poorly suited. Growing well managed grasses and legumes for pasture is an effective means of controlling erosion on these soils. Overgrazing or grazing when the soils are wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

The Gasconade soil generally is unsuitable for building site development and onsite waste disposal because of the shallow depth to bedrock, Rock outcrop, and steepness of slopes.

The Goss soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand and gravel to prevent damage caused by shrinking and swelling of the soil. The site can be landscaped to modify the slope, or dwellings and filter

fields should be designed to conform to the slope. Large stones should be removed from the building site. The septic tank filter field can be designed to extend the length of the laterals and backfilled with material free of stones to compensate for the moderate permeability and reduced absorption capacity caused by the chert. Sewage lagoons generally can be placed on less sloping areas, but sites need to be leveled to modify the slope and sealed with slowly permeable material to prevent seepage. These soils are suitable for local roads and streets, but depth to rock, slope, low strength, the moderate shrink-swell potential of the subsoil, and frost action are limitations. Roads built on the Goss soil generally require some cutting and filling or should be designed to complement the slope. Roads built on the Gasconade soil should be designed to complement the slope, or additional fill or blasting generally is needed. On the Goss soil the roads can be strengthened by adding suitable material to prevent damage caused by low strength. In addition, roads should be graded to shed water and adequate side ditches and culverts provided to help prevent damage caused by shrinking and swelling of the soil and frost action.

These Goss and Gasconade soils are in capability subclass VIIs. The Goss soil is in woodland suitability subclass 4f, and the Gasconade soil is in woodland suitability subclass 5d.

45D—Clarksville very cherty silt loam, 5 to 14 percent slopes. This deep, moderately sloping and strongly sloping, somewhat excessively drained soil is on ridgetops and side slopes on uplands. Individual areas are long, narrow, and irregular in shape and range from about 10 acres to more than 400 acres. Coarse fragments of chert are on the surface.

Typically, the surface layer is dark grayish brown, very friable very cherty silt loam about 4 inches thick. The subsurface layer is grayish brown, pale brown, and light yellowish brown, friable very cherty and extremely cherty silt loam about 28 inches thick. The subsoil extends to a depth of 60 inches or more. It is multicolored, friable extremely cherty silty clay loam in the upper part and multicolored, firm, very cherty clay in the lower part. In places the lower side slopes are moderately steep. In other places the upper part of the subsoil is very cherty silty clay. Some areas are moderately steep.

Included with this soil in mapping and making up about 10 percent of the map unit are areas of clayey Doniphan soil on ridgetops and side slopes.

Permeability is moderately rapid in this Clarksville soil. Surface runoff is rapid. The available water capacity is low. The subsoil ranges from strongly acid to very strongly acid. The natural fertility is low. The organic matter content is moderately low.

Most areas of this soil are in woodland. A few small areas are used for hay and pasture. This soil generally is unsuited to row crops because of the slope and the content of chert. This soil is moderately well suited to trees, and most areas remain in native hardwoods and native pine. The use of mechanical tree planting equipment and site preparation equipment is restricted because of the chert content of the soils. Planting seedlings by hand or direct seeding may be necessary. In addition, planting stock of larger size than usual may be needed to improve the chances of seedling survival.

This soil is moderately well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for pasture is an effective means of controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Land shaping can be used to modify the slope, or dwellings should be designed to complement the slope. Septic tank filter fields should be designed to operate on the slope or the area shaped to modify the slope. An alternative is to pipe the sewage to adjacent areas that are more suitable for disposal facilities. This soil generally is unsuitable for sewage lagoons because of seepage and slope. This soil is suitable for local roads and streets, but slope and frost action are limitations. Some cutting and filling may be necessary, or the roads should be designed to complement the slope. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by frost action.

This Clarksville soil is in capability subclass VIs and woodland suitability subclass 4f.

45E—Clarksville very cherty silt loam, 14 to 20 percent slopes. This deep, moderately steep, somewhat excessively drained soil is on side slopes of ridges on uplands. Individual areas are moderately long, narrow, and irregular in shape and range from about 10 acres to more than 500 acres. Coarse fragments of chert are on the surface. Some small areas are stony. Escarpments of limestone Rock outcrop are in a few places.

Typically, the surface layer is dark grayish brown, very friable very cherty silt loam about 2 inches thick. The subsurface layer is pale brown and yellowish brown, friable very cherty silt loam about 10 inches thick. The subsoil extends to a depth of 60 inches or more. It is brown, friable very cherty silt loam in the upper part; strong brown, friable extremely cherty silty clay loam in the next part; multicolored, firm, extremely cherty silty clay loam below that; and multicolored, firm extremely cherty clay and very cherty clay in the lower part. Escarpments and parts of some of the lower side slopes are steep.

Included with this soil in mapping and making up about 10 percent of the map unit are areas of Goss soils that have more clay in the subsoil than the Clarksville soil.

These areas are on nose slopes and the upper part of side slopes.

Permeability is moderately rapid in this Clarksville soil. Surface runoff is rapid. The available water capacity is low. The subsoil ranges from strongly acid to very strongly acid. The natural fertility is low. The organic matter content is moderately low.

Most areas of this soil are in pasture and woodland. A few areas are used for hay. This soil is unsuited to row crops because of slope and the content of chert. This soil is poorly suited to cool-season grasses, warm-season grasses, and some kinds of legumes; growing well managed grasses and legumes for pasture, however, is the most effective means of controlling erosion on areas that have been cleared. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is moderately well suited to trees, and many areas remain in native hardwoods. The use of tree harvesting equipment, mechanical tree planting equipment, and site preparation equipment is limited because of slope and the content of chert in the soil. Roads and skid trails should be placed on the contour. Planting seedlings by hand or direct seeding may be necessary. Seedling mortality is moderate on this soil, but planting special stock of larger size than usual can overcome this limitation.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Land shaping can be used to modify the slope, or dwellings should be designed to complement the slope. Septic tank filter fields should be designed to operate on the slope, or sewage generally can be piped to adjacent areas that are more suitable for disposal facilities. This soil generally is unsuitable for sewage lagoons because of seepage and slope. This soil is suitable for local roads and streets, but slope and frost action are limitations. Some cutting and filling may be needed, or the road should be designed to complement the slope. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by frost action.

This Clarksville soil is in capability subclass VIIs and woodland suitability subclass 4f.

45F—Clarksville very cherty silt loam, 20 to 35 percent slopes. This deep, steep, somewhat excessively drained soil is on side slopes of ridges on uplands. Individual areas are long, narrow, and irregular in shape along the sides of the ridges and wider below the heads of draws. They range from about 10 to more than 400 acres. Some small areas are stony. Escarpments of limestone Rock outcrop are in places.

Typically, the surface layer is dark grayish brown, very friable very cherty silt loam about 4 inches thick. The subsurface layer is brown and light yellowish brown, friable very cherty silt loam about 19 inches thick. The subsoil extends to a depth of 65 inches or more. It is multicolored, friable extremely cherty silty clay loam in the upper part and strong brown, mottled, firm extremely cherty silty clay loam in the lower part. In some places the slope is moderately steep, and in other places it is very steep.

Included with this soil in mapping and making up about 10 to 15 percent of the map unit are areas of Doniphan soils and other more clayey, less cherty soils. Doniphan soils have more clay in the subsoil than Clarksville soils. They and some of the other included soils are upslope and at the heads of draws. The rest are downslope.

Permeability is moderately rapid in this Clarksville soil. Surface runoff is rapid. The available water capacity is low. The subsoil ranges from strongly acid to very strongly acid. The natural fertility is low. The organic matter content is moderately low.

Most areas of this soil are in woodland. Some areas are used for pasture. This soil is unsuited to row crops because of slope and the content of chert. It is moderately well suited to trees, and most areas remain in native hardwoods, together with some native pine. The use of tree harvesting equipment, mechanical tree planting equipment, and site preparation equipment is restricted because of slope and the content of chert in the soil. Roads and skid trails should be placed on the contour. In places yarding the logs uphill to logging roads or skid trails may be required. Planting seedlings by hand or direct seeding may be necessary. Seedling mortality is moderate, but this limitation can be overcome by planting special stock of larger size than usual.

This soil is poorly suited to cool-season grasses, warm-season grasses, and some kinds of legumes; growing well managed grasses and legumes for pasture, however, is the most effective means of controlling erosion on areas that have been cleared. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Slope should be modified by land shaping, or dwellings should designed to complement the slope. Septic tank filter fields should be designed to operate on the slope, or sewage generally can be piped to adjacent areas that are more suitable for disposal facilities. This soil generally is unsuitable for sewage lagoons because of seepage and slope. This soil is suitable for local roads and streets, but slope and frost action are limitations. Some cutting and filling may be necessary, or the roads can be designed to complement the slope. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by frost action.

This Clarksville soil is in capability subclass VIIs and woodland suitability subclass 4f.

45G—Clarksville very cherty silt loam, 35 to 60 percent slopes. This deep, very steep, somewhat excessively drained soil is on side slopes of ridges on uplands. Individual areas are long and narrow along the sides of ridges and wider below the heads of draws. They range from about 25 acres to more than 1,000 acres. Coarse fragments of chert are on the surface. Small stony areas and escarpments of limestone Rock outcrop are in this map unit.

Typically, the surface layer is dark grayish brown and dark brown, very friable very cherty silt loam about 2 inches thick. The subsurface layer is brown, friable very cherty silt loam about 12 inches thick. The subsoil extends to a depth of 65 inches or more. It is brown, friable very cherty silt loam in the upper part; brown, mottled, friable extremely cherty silty clay loam in the middle part; and brown and strong brown, friable extremely cherty silty clay loam in the lower part. In places the slopes are less steep.

Included with this soil in mapping and making up about 5 to 10 percent of the map unit are areas of soils that have more clay and less chert. These soils are on lower side slopes and at the heads of draws.

Permeability is moderately rapid in this Clarksville soil. Surface runoff is rapid. The available water capacity is low. The subsoil ranges from strongly acid to very strongly acid. The natural fertility is low. The organic matter content is moderately low.

Most areas of this soil are in woodland. Some areas are used for pasture. This soil is unsuited to row crops because of slope and the content of chert. It is moderately well suited to trees, and most areas remain in native hardwoods, together with some native pine. The hazard of erosion is severe on this soil because of the very steep slopes, but this hazard can be overcome if special erosion control measures are implemented. Careful design and construction of roads and skid trails are needed to minimize the steepness and length of slopes and the concentration of water. Seeding disturbed areas may be necessary after harvesting is completed. The use of tree harvesting equipment, mechanical tree planting equipment, and site preparation equipment is restricted, but this limitation can be overcome by yarding logs uphill to logging roads or skid trails. Planting seedlings by hand or direct seeding may be necessary. Because seedling mortality is severe on this soil, planting special stock of larger size than usual may be required.

This soil is poorly suited to cool-season grasses, warm-season grasses, and some kinds of legumes; growing well managed grasses and legumes for pasture, however, is the most effective means of controlling erosion on areas that have been cleared. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil generally is unsuitable for building site development and onsite waste disposal because of seepage and the very steep slopes.

This Clarksville soil is in capability subclass VIIs and woodland suitability subclass 4f.

55A—Huntington silt loam, 0 to 3 percent slopes. This deep, nearly level, well drained soil is on flood plains. It is subject to occasional flooding. Individual areas are moderately wide to narrow, long, and irregular in shape. They range from about 10 acres to more than 700 acres.

Typically, the surface layer is dark brown, very friable silt loam about 11 inches thick. The subsoil is brown, friable silt loam to a depth of 62 inches or more. The dark surface layer is as much as 24 inches thick near the stream channels. In places the surface layer is grayish brown, and the subsoil has more clay. In old stream channels the lower part of the subsoil and substratum are grayer. In other places the lower part of the subsoil and substratum are gravelly or sandy.

Included with this soil in mapping and making up about 10 to 15 percent of the map unit are areas of Cedargap, Peridge, and Secesh soils. Cedargap soils have more chert and are on the fans and frequently flooded narrow strips along the stream channel. Peridge soils have more clay in the subsoil and are on high stream terraces. Secesh soils have more chert and clay in the subsoil and are on flood plains. Also included are gravel bars, which are common along the inside bends of the streams.

Permeability is moderate in this Huntington soil. Surface runoff is medium. The available water capacity is very high. A seasonal water table is at a depth of 4 to 6 feet from December to April in most years. The subsoil ranges from mildly alkaline to medium acid. The natural fertility is medium. The organic matter content is moderate or high.

Most areas of this soil are used for hay and pasture. Some areas are used for row crops. A few areas are in woodland. This soil is well suited to cool-season grasses, warm-season grasses, and legumes. Growing well managed stands of grasses and legumes is an effective means of controlling scouring of the soil during flooding. Overgrazing or grazing when the soil is wet causes surface compaction and reduces the stand of grasses and legumes. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is well suited to row crops and small grains. If this soil is used for intertilled row crops, scouring of the soil during flooding is a hazard. Conservation tillage, winter cover crops, and the use of diversion terraces help to protect the soil from scouring and from the excess runoff from uplands. Returning crop residue or the regular addition of other organic material helps to

improve fertility, reduce crusting, and increase water infiltration.

This soil is well suited to trees, and a few small areas remain in native hardwoods. Plant competition can be overcome by careful and thorough site preparation, including prescribed burning, spraying, or cutting. Release treatment may be necessary to ensure development. There are no other limitations or hazards for planting or harvesting trees.

This soil generally is unsuited to building site development or onsite waste disposal because of occasional flooding.

This Huntington soil is in capability subclass IIw and woodland suitability subclass 1o.

81B—Tonti silt loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on ridgetops and high terraces. Individual areas are irregular in shape and range from about 10 acres to more than 1,500 acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil above the fragipan is about 15 inches thick. The upper part is yellowish brown, friable silt loam; the middle part is brown, friable silty clay loam; and the lower part is yellowish brown and strong brown, mottled, friable cherty silty clay loam. The fragipan is multicolored, firm, brittle very cherty silty clay loam about 18 inches thick. The subsoil below the fragipan is red, mottled, firm extremely cherty clay to a depth of 62 inches or more. In some places the subsoil has less content of fine chert. In other places the slopes are moderate.

Included with this soil in mapping and making up as much as 10 to 15 percent of the map unit are areas of Wilderness soils that are downslope from Tonti soils. The Wilderness soils have a cherty surface layer and contain more chert in the subsoil.

Permeability is moderate above the fragipan and slow in the fragipan in this Tonti soil. Surface runoff is medium. The available water capacity is low. A perched water table is at a depth of 1.5 to 2.5 feet from December to April in most years. The subsoil ranges from strongly acid to very strongly acid. The natural fertility is low. The organic matter content is moderately low. The shrink-swell potential is moderate. Rooting depth is restricted by a fragipan between depths of 15 and 24 inches.

Most areas of this soil have been cleared and are used for hay (figs. 14 and 15) and pasture. A few areas are used for row crops, and a few areas are in woodland. This soil is well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for hay and pasture is an effective means of controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

Figure 14.—Red clover on Tonti silt loam, 2 to 5 percent slopes.

This soil is moderately well suited to row crops. If the soil is used for intertilled row crops, erosion is a hazard. Conservation tillage, winter cover crops, terraces and contour farming where the slopes are long enough and smooth enough, and grassed waterways help to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is moderately well suited to trees, and a few small areas remain in native hardwoods. Seedling mortality and the hazard of windthrow are limitations. Planting special stock of larger size than usual and using lighter, less intensive, and more frequent thinnings to reduce stand density can overcome these limitations.

This soil is suitable for building site development and for onsite waste disposal if proper design and installation procedures are used. Concrete footings, foundations, and basement walls should be designed and constructed with adequate reinforcement steel and backfilled with sand or gravel to prevent damage caused by shrinking and swelling of the soil. Tile drains can be installed around footings to prevent damage caused by seasonal wetness. This soil generally is unsuited to septic tank filter fields because of slow permeability and seasonal wetness. Sewage lagoon sites may need to be leveled to modify the slope but should function adequately if

Figure 15.—Fescue hay in large round bales on Tonti silt loam, 2 to 5 percent slopes.

properly designed and constructed. This soil is suitable for local roads and streets, but low strength, seasonal wetness, and frost action are limitations. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by wetness and frost action.

This Tonti soil is in capability subclass IIIe and woodland suitability subclass 4d.

83G—Gasconade-Rock outcrop complex, 9 to 65 percent slopes. This map unit consists of shallow, strongly sloping to very steep, somewhat excessively drained Gasconade soil and dolomite or limestone Rock outcrop. It is on rough, broken side slopes and knobs of uplands. The percentage of Gasconade soil and Rock outcrop varies from place to place but averages about 65 percent Gasconade soil and 25 percent Rock outcrop. Individual areas are irregular in shape and range from about 10 acres to more than 400 acres. Dolomite and chert stones are on the surface in parts of this map unit. In other places sandstone bedrock is near the surface and on the surface.

Typically, the Gasconade soil has a surface layer of very dark brown, firm flaggy silty clay about 10 inches thick. The subsoil is very dark grayish brown, firm flaggy silty clay about 7 inches thick. Hard dolomite is at a depth of about 17 inches. In some places the subsoil is red. In other places the soil material is less than 4 inches thick over bedrock. A few areas are moderately sloping.

Rock outcrop consists of areas of exposed dolomite bedrock and areas of limestone and sandstone bedrock.

Included with the Gasconade soil and Rock outcrop in mapping and making up as much as 5 to 10 percent of the map unit are areas of well drained Bardley soils and moderately well drained Gatewood soils. These soils, which are in random pockets, are 20 to 40 inches thick over dolomite bedrock. Also included are some areas on ridgetops that are gently sloping.

Permeability is moderately slow in this Gasconade soil. Surface runoff is rapid. The available water capacity is very low. The subsoil ranges from mildly alkaline to slightly acid. The natural fertility is medium. The organic matter content is moderate. The shrink-swell potential is moderate. Rooting depth is restricted between depths of 4 and 20 inches by hard dolomite or limestone bedrock.

Most of the acreage is idle glades in woodland and marginal pasture. This soil is unsuited to cultivated row crops because of steep slopes, the cherty or flaggy content of the soil, shallow depth to bedrock, and Rock outcrop.

This soil is poorly suited to trees. Many areas remain in native warm-season grasses, native eastern redcedar, and scrub hardwoods. Trees are harvested mostly for posts. Erosion is a hazard on this soil. Careful design and construction of roads and skid trails are needed to minimize the steepness and length of slope and the concentration of water. Steepness of slope and a flaggy or cherty soil restrict the use of equipment, but these limitations can be minimized by placing roads and skid trails on the contour or, where necessary, by yarding the logs uphill to logging roads and skid trails. Seeding disturbed areas may be needed after harvesting is completed. Because the use of tree planting equipment and site preparation equipment is severely restricted, planting seedlings by hand or direct seeding may be necessary. Seedling mortality and windthrow can be reduced by planting stock of larger size than usual and by lighter, less intensive, and more frequent thinnings to reduce stand density.

This soil is poorly suited to cool-season grasses, warm-season grasses, and legumes. Growing well managed grasses and legumes for pasture, however, is an effective means of controlling erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil generally is unsuitable for building site development and onsite waste disposal because of the shallow depth to bedrock, Rock outcrop, and steep slopes.

This Gasconade soil and Rock outcrop are in capability subclass VIIs. The Gasconade soil is in woodland suitability subclass 5d.

92A—Cedargap-Secesh silt loams, 0 to 3 percent slopes. This map unit consists of deep, nearly level, well drained soils on flood plains. The Cedargap soil is adjacent to the stream channel, and the Secesh soil is on a higher flood plain adjacent to the upland. Flooding is frequent on the Cedargap soil and occasional on the Secesh soil. This map unit is about 55 percent Cedargap soil and 30 percent Secesh soil. Individual areas are long and moderately wide to narrow. They are irregular in shape and range from about 10 acres to more than 400 acres.

Typically, the Cedargap soil has a surface layer of dark brown, very friable silt loam about 12 inches thick. The subsurface layer is dark brown, very friable and friable cherty and extremely cherty silt loam about 30 inches thick. The substratum extends to a depth of 65 inches or more. It is very dark brown, friable extremely cherty clay loam in the upper part and dark reddish brown, friable very cherty silty clay loam in the lower part. In places the surface layer is cherty.

Typically, the Secesh soil has a surface layer of dark brown, very friable silt loam about 10 inches thick. The subsoil extends to a depth of 65 inches or more. It is brown, friable silt loam in the upper part; reddish brown, friable silty clay loam in the middle part; and reddish brown, mottled, firm extremely cherty clay loam and multicolored, firm extremely cherty clay loam in the lower part. Some areas adjacent to the upland are gently sloping.

Included with these soils in mapping and making up about 15 percent of the map unit are areas of Huntington soils and other cherty soils. The Huntington soils are on wider areas of the flood plains and are free of chert. The other soils are near the stream channel on the flood plain and on foot slopes.

Permeability is moderately rapid in this Cedargap soil. Surface runoff is slow. The available water capacity is moderate. The substratum ranges from neutral to medium acid. The natural fertility is medium. The organic matter content is moderately low or moderate.

Permeability is moderate in this Secesh soil. Surface runoff is slow. The available water capacity is moderate. The subsoil ranges from very strongly acid to medium acid. The natural fertility is low. The organic matter content is moderately low.

Most areas of these soils are in hay and pasture. A few areas are used for row crops or are in woodland (fig. 16). These soils are well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for pasture is an effective means of controlling scouring caused by flooding. Overgrazing or grazing when the soils are wet causes surface compaction and reduces the stand of

Figure 16.—Young walnut trees on Cedargap-Secesh silt loams, 0 to 3 percent slopes.

grasses and legumes. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soils in good condition.

These soils are well suited to row crops and small grains; however, scouring caused by flooding is a hazard. Conservation tillage, winter cover crops, and diversion terraces help to protect these soils from erosion, from scouring caused by flooding, and from excessive runoff from the uplands. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The Cedargap soil is well suited to trees, and the Secesh soil is moderately well suited to trees. A few areas remain in native hardwoods. Seedling mortality and plant competition are limitations on the Cedargap soil, but these limitations can be overcome by planting special stock of larger size than usual and by careful and thorough site preparation, including prescribed burning, spraying, or cutting. Release treatment may be necessary to ensure development.

These soils generally are unsuitable for building site development and onsite waste disposal because of frequent flooding on the Cedargap soil and occasional flooding on the Secesh soil.

These Cedargap and Secesh soils are in capability subclass IIs. The Cedargap soil is in woodland suitability

subclass 3f, and the Secesh soil is in woodland suitability subclass 4o.

93A—Cedargap cherty silt loam, 0 to 3 percent slopes. This deep, nearly level, well drained soil is on low flood plains. Flooding is frequent. Individual areas are long, narrow, and irregular in shape and range from about 10 acres to more than 200 acres.

Typically, the surface layer is dark brown, very friable cherty silt loam about 10 inches thick. The subsurface layer is dark brown, friable very cherty silt loam about 15 inches thick. The substratum extends to a depth of 60 inches or more. It is brown and dark brown, friable extremely cherty silty clay loam in the upper part and reddish brown, firm very cherty silty clay loam in the lower part. In a few places the soil is moderately deep to chert.

Included with this soil in mapping and making up about 10 to 15 percent of the map unit are soils that have dark layers less than 10 inches thick. These soils are on the flood plain near the stream channels and on foot slopes. Some foot slopes are moderately steep.

Permeability is moderately rapid in this Cedargap soil. Surface runoff is slow. The available water capacity is low. The substratum ranges from neutral to medium acid. The natural fertility is medium. The organic matter content is moderately low or moderate.

Most areas of this soil are in hay and pasture. Some areas are in woodland. This soil is moderately well suited to row crops but because of smallness of the areas, droughtiness, and frequent flooding, it usually is not cultivated. This soil is moderately well suited to cool-season grasses, warm-season grasses, and some kinds of legumes. Growing well managed grasses and legumes for hay and pasture is an effective means of controlling scouring resulting from flooding. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is well suited to trees, and some areas remain in native hardwoods. Seedling mortality and plant competition are limitations, but these limitations can be overcome by planting special stock of larger size than usual and by careful and thorough site preparation, including prescribed burning, spraying, or cutting. Release treatment may be necessary to ensure development.

This soil generally is unsuitable for building site development and onsite waste disposal because of frequent flooding.

This Cedargap soil is in capability subclass IIIs and woodland suitability subclass 3f.

94—Pits-Dumps complex. This map unit consists of open excavations or pits from which limestone or dolomite has been quarried or is now being quarried; nearly level to steep dumps of waste rock and soil material; and stockpiles of marketable stone. Pits and Dumps make up about 85 percent of this map unit. They are about equal in extent of acreage. Individual areas range from less than 10 acres to 50 acres or more.

Typically, each side of a pit or quarry has a vertical face or exposure of limestone or dolomite rock. These exposures extend from the bottom of the pit to a height of about 10 to 40 feet. Above the limestone or dolomite rock the overburden of soil and unconsolidated soil material is about 5 to 15 feet thick. Before quarrying, this overburden is removed. Waste rock fragments and soil material are dumped, and the marketable stone is stockpiled while the stone is being quarried and processed. Buildings, roads, and other structures and works used in processing the stone or in manufacturing the lime cover most of the rest of the area.

Included in mapping and making up as much as 15 percent of the map unit are areas of Gasconade, Gatewood, Goss, and Ocie soils. In places the surface layer of the included soils has a thin cover of finely broken stone or chert and other debris. The Gasconade soils are on the landscape breaks. The gently sloping to strongly sloping Gatewood, Goss, and Ocie soils are on the sides and tops of ridges on uplands.

Permeability is restricted in the included soil areas. Runoff is medium to rapid, and available water capacity is low.

Droughtiness and susceptibility to erosion are severe restrictions to the growth of plants in this map unit. Large parts of many of the areas are void of vegetation; however, a scant cover of grasses, weeds, and brush grows on the dumps of soil material, and a good or fair vegetative cover grows on the included soils. The vegetation covering the abandoned quarries, especially in rural areas, can be grazed, but the vegetated areas on most of the still operating quarries cannot be grazed or otherwise used. Most areas where quarry operations are completed or have been abandoned have potential for certain recreational uses, wildlife habitat development, and storage of selected waste material. Reclaimed land around and between the pits has potential for grazing, especially in rural areas. Because areas of this map unit are so variable, onsite investigation is needed to determine the potential and limitations for any proposed use.

The Pits and Dumps complex is not assigned to a capability subclass or woodland suitability subclass.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. The acreage of high quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are the soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not frequently flooded during the growing season. The slope ranges mainly from 0 to 5 percent. More detailed information on the criteria for prime farmland can be obtained from the local staff of the Soil Conservation Service or the Missouri University Extension Service.

About 28,000 acres or 8 percent of Christian County meets the soil requirements for prime farmland. Areas are scattered throughout the county but are mostly in the northern part in associations 2, 3, 4, and 5 of the general soil map. Most of the prime farmland soils in Christian County are used for hay and pasture.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to housing developments. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, or difficult to cultivate and usually are less productive than prime farmland.

Soil map units that make up prime farmland in Christian County are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units."

Soils that have limitations because of flooding may qualify for prime farmland if this limitation is overcome by measures for flood control. In table 5, the measures used to overcome these limitations, if they occur, are shown in parentheses following the map unit name. Onsite evaluation is necessary to determine the effectiveness of the corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Approximately 207,000 acres in Christian County is used for pastureland, hayland, and cropland. The 157,000 acres of pastureland is predominantly cool-season grasses, but an occasional seed crop or hay crop is grown on a part of this acreage. Approximately 47,900 acres is used for hay production. Some of this acreage is grazed late in summer and fall. Row crops are grown on about 1,700 acres. The rest of the acreage in the county consists of about 127,000 acres in woodland and about 29,000 acres that has been used for towns, highways and roads, and housing developments in rural areas. A few miscellaneous uses are included.

The acreage used for housing developments has significantly increased during the last decade, particularly in the northern part of the county. This land use change will put continuing pressure on the farmland in Christian County (fig. 17).

The soils in Christian County are moderately well suited to increased crop production on pastureland, hayland, and cropland. About 63,000 acres of this land is nearly level to gently sloping, of which about 28,000 acres could qualify as prime farmland. An additional 78,000 acres that is moderately sloping is suited to pastureland and hayland if properly managed, and about 78,000 acres that is strongly sloping to moderately steep is suited to pastureland if properly managed. Crop production can also be increased by extending the latest technology to all pastureland, hayland, and cropland in the county. This survey can help facilitate the application of such technology.

Soil erosion is the major management concern on about 15 percent of the pastureland, hayland, and cropland in Christian County. All soils that have slopes of more than 2 percent are susceptible to erosion damage if not protected by vegetative cover or mechanical methods. Bolivar, Captina, Creldon, Peridge, and Tonti soils are the most intensively farmed soils in the county and are most susceptible to severe erosion. Loss of the surface layer reduces fertility, available water capacity, and tilth. This loss is especially damaging to the Bolivar,

Figure 17.—Soybeans on Captina-Needleye silt loams in the foreground, and housing development on Tonti silt loam in the background. The housing development is encroaching onto prime farmland.

Captina, Creldon, and Tonti soils, which have a limited rooting depth caused by depth to bedrock or a fragipan. The eroded soil material enters water impoundments and streams. Control of erosion is essential in order to minimize water pollution by sediment and improve the water quality for domestic, municipal, and recreational uses.

If properly managed, grasses and legumes grown for hay or pasture can reduce soil loss below tolerable limits. Conservation tillage that does not invert the soil and leaves crop residue on or near the surface helps to increase infiltration, maintain good tilth, and reduce runoff and erosion. The use of no-till grass and legume seeders and row crop planters substantially reduces the amount of soil disturbed as compared with conventional methods, thereby reducing erosion and the amount of chert on the surface in areas where the soil is cherty. Delaying plowing until spring leaves crop residue on the surface throughout the fall and winter and helps to protect the soil from erosion. Contouring and contour stripcropping are erosion control practices that are applicable to some areas of Christian County. These practices are best adapted to soils that have reasonably smooth and uniform slopes, such as Captina, Creldon, Needleye, Peridge, and Tonti soils. These deep, well drained and moderately well drained soils also are suited to terracing, a practice which reduces the length of slope and minimizes erosion.

Natural soil fertility is low in most of the soils in Christian County. An exception is the Huntington and Cedargap soils, which are on bottom lands. All of the soils in Christian County need additions of plant food for maximum production. Nearly all of the soils in the county are naturally acid in the upper part of the root zone.

These soils need applications of ground limestone or ground dolomite to raise the pH and calcium and magnesium levels for good legume growth. Applications of lime and fertilizer on all soils should be based on the results of a soil test, on crop needs, and on the expected yield.

Soil tilth is an important factor in seedbed preparation, the germination of seeds, and the infiltration of water into the soil. Soils that have good tilth are granular and porous. Many of the soils in Christian County have silt loam surface layers that are low or moderately low in organic matter content. The soil structure of frequently tilled soils is weak, and intense rainfall causes the surface to crust. This crust reduces infiltration and increases runoff. Returning crop residue, plowing under green manure, and adding animal manures to the soil improve the soil structure, thereby reducing crusting and increasing the infiltration rate.

Pasture and hay crops that are well suited to the soils and climate of Christian County include several kinds of legumes, cool-season grasses, and warm-season grasses. Alfalfa and red clover are the common legumes grown for hay. Deep, well drained soils that have high available water capacity and that are high in content of calcium and magnesium or are adequately limed, are well suited to alfalfa for hay production. Huntington and Peridge soils are examples. Cedargap and Secesh soils are moderately well suited to alfalfa and red clover for hay production. Soils that have a fragipan, limited depth to bedrock, or seasonal wetness are better suited to clovers for hay or pasture production. If adequately limed and fertilized, most of the soils suited to pasture and hay production can support red clover, Ladino clover, and other clovers. Tall fescue, orchardgrass, and the other cool-season grasses are suited to most of the soils in the county. These grasses grow best in spring, early in summer, and in fall. Where additional midsummer pasture or hay is needed, native warm-season grasses and warm-season legumes can be grown. Deep, well drained soils that have high available water capacity are well suited to tall, warm-season grasses, such as indiangrass, big bluestem, and switchgrass. Huntington and Peridge soils are examples. Soils that have restricted water capacity are moderately well suited to tall, warm-season grasses. Bolivar, Captina, Cedargap, Clarksville, Creldon, Doniphan, Gatewood, Goss, Needleye, Ocie, Secesh, Tonti, and Wilderness soils are examples. Warm-season grasses grow best late in spring, in summer, and early in fall.

The deep Huntington and Peridge soils are well suited to row crops, such as corn and soybeans. Soils that have a restricted rooting depth or other properties that reduce the available water capacity, for example, Captina, Cedargap, Creldon, Needleye, Secesh, and Tonti soils, are moderately well suited to row crops, such as corn and soybeans. Bolivar, Captina, Cedargap, Creldon, Needleye, Peridge, Secesh, and Tonti soils are well suited to small grains, such as winter wheat.

Specialty crops grown commercially in Christian County are apples, blueberries (fig. 18), grapes (fig. 19), and strawberries. Most specialty crops grow best on deep, well drained soils that have high available water capacity, and good natural airflow and that warm up early in spring. The climate in the county is not well suited to many of the specialty crops. Deep, well drained soils that have high available water capacity are usually in low areas that are subject to damage from late frost. Soils that warm up early in spring and have good natural airflow are either droughty because of excess chert or have limited rooting depth because of a fragipan or bedrock. Strawberries are best suited to the soils in Christian County. Demand for specialty crops may increase because of the favorable location to markets in the Springfield area.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Figure 18.—Blueberries on Peridge silt loam, 2 to 5 percent slopes.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey (*8*). These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production. There are no Class I, Class V, or Class VIII soils in Christian County.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, or s* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony. The capability classification of each map unit, except Pits-Dumps complex, a miscellaneous area, is given in the section "Detailed Soil Map Units."

Figure 19.—Grapes on Doniphan-Clarksville cherty silt loams, 2 to 14 percent slopes.

Woodland Management and Productivity

James L. Robinson, forester, Soil Conservation Service, assisted in the preparation of this section.

Originally, forest covered most of Christian County. Some prairie was in the Creldon association, and natural openings in the otherwise continuous forest occurred in scattered areas of shallow soils in the "Ozark glades."

According to the 1972 survey, commercial forest made up 35 percent of the total land area in Christian County. The predominant forest type is oak-hickory, which is typical of the Ozark region.

Soils help to provide an understanding of forest types and how tree growth occurs. Some relationships have been recognized for a long time. For example, white oak grows well on deep, moist soils, and blackjack or post oak is dominant in areas where rooting depth is restricted or where moisture supply is limited. The soils serve as a reservoir for moisture, provide an anchor for roots, and supply most of the available nutrients. Soil properties that directly or indirectly affect these growth requirements are reaction, fertility, drainage, texture, structure, depth, and position on the landscape.

Available water capacity is mainly influenced by texture, rooting depth, and the content of stones and chert in the soil. Deep, loamy and silty soils, such as Peridge soil, have high available water capacity. In Goss soil and similar soils, the stone or chert content affects the amount of available water. Tree growth is more adversely affected by the stone and chert content in the subsoil than in the surface layer. A fragipan and shallow depth to bedrock also affect the available water capacity because they restrict root development. Little can be done to change the physical limitations of the soil, but good management of tolerant plant species can help to overcome these limitations.

The supply of nutrients also affects tree growth. The mineral horizons of the soil are important sources of nourishment. Many soils on uplands have subsoils that are leached and contain few nutrients, but most bottom land soils have substrata that have larger amounts of nutrients. The layer of leaf litter on the surface of the soil is equally important. Decomposition of this layer recycles nutrients that have accumulated in the forest ecosystem over long periods. Fire, excessive trampling by livestock, and erosion can result in loss of these nutrients. Forest management should include the prevention of wildfires and protection from overgrazing.

Other characteristics that affect tree growth are aspect and position on the landscape. These characteristics influence such factors as the amount of sunlight (energy) available, air drainage, soil temperature, and moisture relationships. On the uplands the north- and east-facing slopes are best suited to tree growth.

Oak-hickory is the predominant forest type in Christian County. Species vary, depending upon the site. In the Clarksville-Doniphan association white oak, northern red oak, and black oak are predominant, together with hickory and other associated species (fig. 20). A small area of the oak-pine forest type is also in this association. This type is similar to oak-hickory but includes shortleaf pine as a major component. In the Clarksville-Doniphan association shortleaf pine should be

Figure 20.—A stand of hardwood trees in the Clarksville-Doniphan association.

favored for establishment on south- and west-facing slopes, in old fields, and wherever the hardwood trees are of poor quality. This association has moderate potential for timber production, and in areas where the existing stand is of good quality, intensive management should be considered. Good management should include improvement of the timber stand.

The Gatewood-Ocie-Gasconade association also has timber stands typical of the oak-hickory type. White oak, black oak, and northern red oak most often grow on the cooler, north- and west-facing slopes on the Ocie and Gatewood soils. Post oak and eastern redcedar make up the largest percentage of timber stands on the south- and west-facing slopes. The Gasconade soil and the south- and west-facing slopes of the Gatewood soil have almost pure stands of eastern redcedar or eastern redcedar and hardwoods. Eastern redcedar should be favored on the Gasconade soil and the less productive sites of the Gatewood soil. The market is very strong for eastern redcedar. The Ocie soil is suitable for conversion to shortleaf pine. Generally, low level management consisting of protection from fire and destructive grazing and better methods of harvest when the timber matures are sufficient for improved production in this association.

In the Goss-Clarksville association black oak, white oak, northern red oak, white ash, black walnut, sugar maple, post oak, hackberry, and hickory are predominant. At one time this area was extensively forested, but much of it has since been converted to

pasture. Most of the remaining timber is on the major Clarksville and Goss soils.

The Bolivar and Tonti-Wilderness associations have mostly small tracts or farm woodlots. Post oak is generally the most abundant tree. Chinkapin oak, white oak, black oak, hickory, and eastern redcedar are included species. Most of the timber areas in these associations are grazed, and trees are mostly used to produce farmstead firewood.

The Peridge-Huntington association is along the major drainageways in the county. Although most of this area has been cleared for more intensive farm use, small tracts of timber grow in odd areas or remote fields. The soils in this association are well suited to the common species and respond to intensive timber management. The Peridge and Huntington soils are well suited to management for the production of black walnut.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Missouri Department of Conservation, the Cooperative Extension Service, or from a commercial nursery.

Figure 21.—A popular swimming spot at Riverdale on Finley Creek in the Peridge-Huntington association.

Recreation

Edward A. Gaskins, biologist, Soil Conservation Service, assisted in the preparation of this section.

According to the facility inventory part of the 1980 Statewide Comprehensive Outdoor Recreation Plan (SCORP), a total of 51,123 acres is used for recreational developments in Christian County (*6*). Ownership of these areas is 99 percent federal. The rest is under state, municipal, school, private, or other control. Facilities include lakes, river sports, swimming areas (fig. 21), hunting and fishing areas, camping, trails, game courts, motorcycle trails, ball fields, picnic areas, play areas, a horse arena, and wildlife viewing areas. A growth of 96.6 percent in the total county population of 30,200 has been projected by 1990 (*3*).

A part of the Mark Twain National Forest, comprising more than 50,000 acres, is the largest public recreational area in the county. This federally owned area has motorcycle trails, fishing and hunting facilities, wildlife viewing areas, and other forms of outdoor recreation available to the general public. The Ozark, Nixa, and Clever City Parks, making up 23 acres, and the state owned Shelvin Rock Access Area, making up 20 acres, are the other publicly owned areas within the county.

The 1974 NACD Nationwide Outdoor Recreation Inventory listed several private and semiprivate, commercial recreational enterprises (*4*). These

enterprises vary from trout fishing areas (fig. 22), places for canoe rentals, and golf courses to hunting areas, church camps, and a campground. Each county committee responsible for preparing the inventory listed a swimming pool and a recreational lake as priority recreational needs.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil

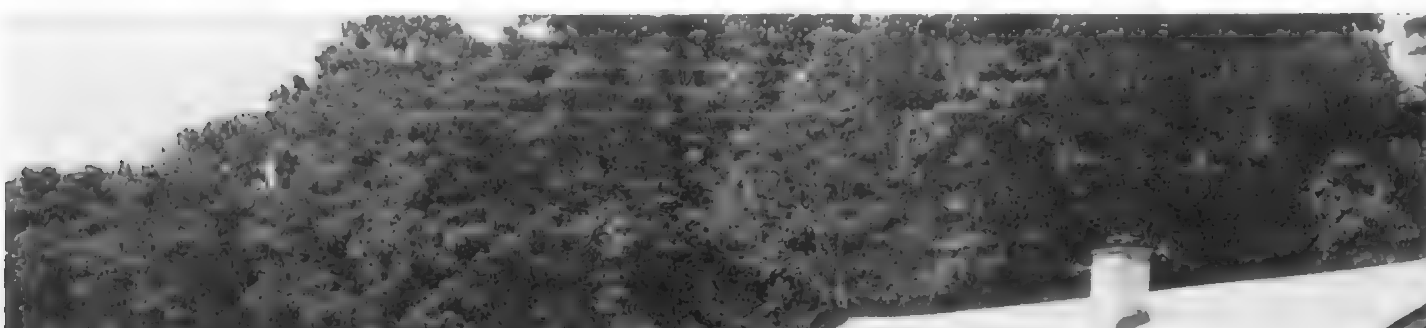


Figure 22.—A commercial trout fishing area in the Goss-Clarksville association.

properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Edward A. Gaskins, biologist, Soil Conservation Service, assisted in the preparation of this section.

Christian County is one of thirteen counties that make up the West Ozark Border Zoogeographic Region in Missouri (*5*). The native vegetation was a mixture of oak-hickory forest and tall grass prairie. At present about 57 percent of the county is grassland and cropland. Pasture is the primary use, and tall fescue is the main pasture plant. Woodland makes up about 35 percent of the county. The rest of the acreage is used for urban development, roads, and miscellaneous purposes. A 96 percent increase in population is projected for Christian County between 1970 and 1990 (*3*).

During the past thirty years a significant amount of forest land has been converted to grassland. Problems affecting the wildlife resource are loss of the habitat base through conversion to pasture and urban uses, grazing of the shrinking woodland base, very limited grain production, enlargement of fields, and lack of suitable edge growth between vegetative types.

There are some state owned public hunting areas in the county. Part of the Mark Twain National Forest, comprising about 50,535 acres, is in the southeastern corner of the county. This area provides public hunting and other related outdoor recreational activities. Most of the wildlife habitat (fig. 23) is controlled by the private landowner, however, and easy access for the purpose of hunting is becoming more difficult to obtain as additional land is posted.

Songbird populations are rated as good to excellent in each of the soil associations. Furbearer populations are also good. Raccoons, opossums, muskrats, gray foxes, coyotes, beaver, striped skunks, and mink are the principal animals trapped for fur in the county. A few remaining prairie species, such as badgers and blacktail jackrabbits, are still reported, although their original grassland habitat is almost nonexistent.

Only the Clarksville-Doniphan and the Gatewood-Ocie-Gasconade associations have more than 50 percent woodland cover. Together with the Goss-Clarksville and Bolivar associations, they provide the main habitat for the woodland wildlife in the county. Deer, turkey, squirrel, and woodcock populations are rated as fair by local conservation officials. Woodcock numbers are increased annually by migratory flights of birds from outside the survey area.

The Creldon, Peridge-Huntington, Tonti-Wilderness, Bolivar, and Goss-Clarksville associations provide the primary habitat for the openland wildlife species in Christian County. Because nearly all row crops are grown for silage, there is a shortage of small grain production. This shortage of small grains limits the food supply for many birds and animals. In addition, overgrazed fescue pastures limit the quality of the grassland habitat. Increasing the warm-season grass acreage would help to improve the quality of the grasslands for use by wildlife. The quail population is rated as poor, and a further decline is projected during the next five years. The number of rabbits is good, and the dove population ranges from poor to fair, depending on small, annual migratory flights into the county.

Wetland habitat is extremely scarce in Christian County. A small section of Wilson Creek is the only

Figure 23.—A wildlife food plot on Ocie-Bardley-Gatewood complex, 2 to 14 percent slopes.

concentrated area used by the few waterfowl. Stable wood duck populations are on sections of the James River and Finley Creek. Surface water is scarce. Only the Peridge-Huntington association provides habitat for wetland wildlife.

Eighty-three miles of perennial streams are listed in the county (*3*). The James River and Finley, Bull, and Swan Creeks are the only waterways that have public sport fisheries. The James River has been seriously polluted by waste from the Springfield metropolitan area. Popular fish species include largemouth, smallmouth, and spotted bass, sucker, paddlefish, crappie, catfish, and various sunfish.

Impoundment type fishing is scarce within Christian County. Only Lindenlure, Ozark, and Riverdale Lakes offer public fishing. Approximately 150 farm ponds and small lakes have been stocked with fish. Largemouth bass, channel catfish, and bluegill are the typical fish in the small impoundments. Although generally not open to the public, farm ponds provide recreational fishing to the landowner, his family, and guests.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are

suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, millet, soybeans, and grain sorghums.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface soil, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are big bluestem, little bluestem, bluegrass, switchgrass, indiangrass, clover, alfalfa, trefoil, and crownvetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are goldenrod, beggarweed, pokeweed, foxtail, croton, and partridgepea.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, wild plum, sumac, persimmon, and sassafras. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn-olive, crabapple, Amur honeysuckle, and hazelnut.

Coniferous plants furnish winter cover, browse, and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cutgrass, cattail, rushes, sedges, and buttonbush.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasants, meadowlarks, field sparrows, cottontails, red foxes, woodchucks, and mourning doves.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkeys, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray foxes, raccoons, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed

performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and shrink-swell potential can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell

potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary

landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount

of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect terraces and diversions and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "cherty." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SC.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*8*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fragiudalfs (*Fragi*, meaning presence of a fragipan, plus *udalf*, the suborder of the Alfisols that have a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Fragiudalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is loamy-skeletal, siliceous, mesic Typic Fragiudalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*7*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*9*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Bardley Series

The Bardley series consists of moderately deep, well drained soils on uplands. Permeability is moderate. These soils formed in clayey residuum from dolomite or limestone. Slopes range from 2 to 14 percent.

Bardley soils are similar to Gatewood soils and commonly are adjacent to Gasconade, Gatewood, and Ocie soils. Gasconade soils are shallower to bedrock than Bardley soils. Gatewood soils are moderately well drained. Ocie soils are deeper to bedrock. These soils are in positions on the landscape similar to those of Bardley soils.

Typical pedon of Bardley very cherty silt loam, from an area of Ocie-Bardley-Gatewood complex, 2 to 14 percent slopes, 1,620 feet west and 2,145 feet south of the northeast corner of sec. 32, T. 26 N., R. 20 W.

Ap—0 to 3 inches; dark grayish brown (10YR 4/2) very cherty silt loam, light brownish gray (10YR 6/2) dry; weak and moderate fine subangular blocky structure separating to fine and medium granular; friable; many fine roots; 40 percent chert fragments; strongly acid; clear smooth boundary.

Bt1—3 to 7 inches; yellowish red (5YR 4/6) cherty silty clay; moderate fine angular blocky structure; firm; common fine roots; common faint clay films on faces of peds; 30 percent chert fragments; very strongly acid; clear smooth boundary.

Bt2—7 to 15 inches; dark red (2.5YR 3/6) and yellowish red (5YR 5/6) clay; weak medium and coarse angular blocky and subangular blocky structure; very firm; few fine roots; common faint clay films on faces of peds; 5 percent chert fragments; strongly acid; clear wavy boundary.

Bt3—15 to 22 inches; mixed dark red (2.5YR 4/6) and brown (7.5YR 5/4) cherty clay; weak medium and coarse angular blocky and subangular blocky structure; very firm; few fine roots; common faint clay films on faces of peds; 15 percent chert fragments; strongly acid; clear wavy boundary.

C—22 to 26 inches; mixed reddish brown (5YR 4/4), strong brown (7.5YR 4/6), and light yellowish brown (10YR 6/4) clay; massive; very firm; few fine roots; 10 percent dolomite fragments; slightly acid; clear wavy boundary.

Cr—26 to 29 inches; weathered dolomite.

R—29 inches; hard dolomite.

The thickness of the solum and depth to bedrock range from 20 to 40 inches. The chert content of the A or Ap horizon ranges from 15 to 70 percent. The Bt subhorizons may individually be as much as 30 percent chert and dolomite fragments.

The A horizon has hue of 10YR or 7.5YR, value of 3 through 5, and chroma of 2 or 3. The Ap horizon has hue of 7.5YR through 10R, value of 3 through 5, and chroma of 2 through 6. It commonly is very cherty silt loam, but the range includes cherty silty clay loam and cherty silty clay. The Bt horizon has hue of 10R to 2.5YR, value of 3 through 5, and chroma of 4 or 6. It is clay or silty clay or their cherty analogues. Reaction is medium acid through very strongly acid except immediately above the bedrock where it is slightly acid through moderately alkaline.

Bolivar Series

The Bolivar series consists of moderately deep, well drained soils on uplands. Permeability is moderate. These soils formed in loamy residuum from acid sandstone and shale. Slopes range from 2 to 14 percent.

The Bolivar soils in this county are taxadjuncts to the Bolivar series because they have a lower base saturation and a thermic temperature regime. This difference, however, does not significantly alter the usefulness or behavior of the soils.

Bolivar soils are similar to Secesh soils and commonly are adjacent to Secesh, Tonti, and Wilderness soils. Secesh soils are deep and they have more chert than Bolivar soils. They are on flood plains. Tonti soils have a fragipan and are in positions on the landscape similar to those of Bolivar soils. Wilderness soils have a fragipan and are on similar or steeper positions.

Typical pedon of Bolivar fine sandy loam, 2 to 5 percent slopes, 1,670 feet west and 1,385 feet north of the southeast corner of sec. 13, T. 27 N., R. 24 W.

Ap—0 to 8 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak and moderate fine granular structure; very friable; many fine roots; slightly acid; clear smooth boundary.

BA—8 to 13 inches; yellowish brown (10YR 5/4) loam; weak fine and medium subangular blocky structure; friable; common fine roots; medium acid; clear smooth boundary.

Bt1—13 to 18 inches; yellowish red (5YR 5/6) sandy clay loam; weak and moderate fine and medium subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—18 to 23 inches; strong brown (7.5YR 5/6) channery sandy clay loam; common medium distinct brown (7.5YR 5/4) and red (2.5YR 4/6) mottles; weak medium and coarse subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; 20 percent sandstone fragments; medium acid; clear smooth boundary.

BC—23 to 33 inches; strong brown (7.5YR 5/6) channery sandy clay loam; common medium distinct reddish brown (2.5YR 5/4) mottles; weak medium and coarse subangular blocky structure; firm; 30 percent sandstone fragments; very strongly acid; clear wavy boundary.

Cr—33 to 60 inches; weathered soft sandstone.

The thickness of the solum and the depth to weathered soft sandstone range from 20 to 40 inches.

The Ap or A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. Where present, the E horizon has hue of 10YR, value of 4 through 6, and chroma of 3 or 4. Some pedons do not have a BA horizon. The Bt horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 4 through 8. It is sandy clay loam or clay loam or the channery or flaggy analogues of these soils. Some pedons do not have a BC horizon.

Captina Series

The Captina series consists of deep, moderately well drained soils that have a fragipan. These soils are on uplands. They formed in a thin layer of loess or other silty material and in cherty residuum from limestone. Permeability is moderate above the fragipan and slow in the fragipan. Slopes range from 1 to 3 percent.

Captina soils are similar to Needleye and Tonti soils and commonly are adjacent to Needleye, Tonti, and Wilderness soils. Needleye soils are grayer above the fragipan than Captina soils. Tonti and Wilderness soils have more chert. Wilderness soils are on the tops and sides of ridges at lower elevations than Captina soils.

Typical pedon of Captina silt loam, from an area of Captina-Needleye silt loams, 1 to 3 percent slopes, 1,915 feet south and 130 feet west of the northeast corner of sec. 2, T. 27 N., R. 21 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak very fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

BA—6 to 10 inches; yellowish brown (10YR 5/6) silty clay loam; weak fine and very fine subangular blocky structure; friable; many fine roots; strongly acid; clear smooth boundary.

Btl—10 to 16 inches; yellowish brown (10YR 5/6) silty clay loam; moderate and strong fine and medium subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; 2 percent chert fragments; strongly acid; clear smooth boundary.

Bt2—16 to 21 inches; yellowish brown (10YR 5/6) silty clay loam; moderate fine and very fine subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; 2 percent chert fragments; strongly acid; clear smooth boundary.

Bt3—21 to 27 inches; mottled yellowish brown (10YR 5/6), pale brown (10YR 6/3), and light brownish gray (10YR 6/2) silty clay loam; weak and moderate fine and medium subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; 2 percent chert fragments; strongly acid; clear smooth boundary.

Btx1—27 to 40 inches; mottled yellowish red (5YR 5/8), strong brown (7.5YR 5/6), light brownish gray (10YR 6/2), and dark grayish brown (10YR 4/2) silty clay loam; weak medium platy structure; very firm; brittle; common faint clay films on faces of peds; extremely acid; gradual smooth boundary.

Btx2—40 to 46 inches; mottled yellowish red (5YR 4/6), strong brown (7.5YR 5/6), light brownish gray (10YR 6/2), light gray (10YR 7/2), and dark grayish·brown (10YR 4/2) silty clay loam; weak medium and thick platy structure; extremely firm; brittle; common faint clay films on faces of peds; extremely acid; gradual wavy boundary.

2Bt4—46 to 63 inches; dark red (2.5YR 3/6) and yellowish red (5YR 4/6) extremely cherty clay; common fine prominent light yellowish brown (10YR 6/4) and dark grayish brown (10YR 4/2) mottles; moderate very fine angular blocky structure; firm; many faint clay films on faces of peds; 65 percent chert fragments; extremely acid.

Thickness of the solum and depth to bedrock are more than 60 inches. Chert content is 0 to 15 percent in the A and B horizons above the fragipan. Chert content in the fragipan ranges from 0 to 75 percent. Below the fragipan the average chert content ranges from about 20 percent to more than 70 percent.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 through 4. The A horizon ranges from strongly acid to slightly acid. The upper part of the Bt horizon has hue of 10YR or 7.5YR, value of 5, and chroma of 6 through 8. It is silt loam or silty clay loam. The lower part has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 through 6. It is cherty, very cherty, extremely cherty, or noncherty silty clay or clay. The Bt horizon ranges from extremely acid to strongly acid. The fragipan has mixed colors of red, gray, and brown, any one of which may dominate. It is silty clay loam or silt loam or their cherty or very cherty analogues. The fragipan ranges from extremely acid to strongly acid. Most pedons have a 2Bt horizon. This horizon has hue of 2.5YR or 5YR, value of 3 through 5, and chroma of 4 through 6. Distinct gray or brown mottles are common. The 2Bt horizon dominantly is very cherty or cherty clay, but it ranges to extremely cherty or cherty silty clay or extremely cherty or cherty silty clay loam.

Cedargap Series

The Cedargap series consists of deep, well drained soils on flood plains of small streams. Permeability is moderately rapid. These soils formed in silty alluvium containing a high percentage of chert. Slopes range from 0 to 3 percent.

Cedargap soils commonly are adjacent to Huntington and Secesh soils. Huntington soils commonly are at a slightly higher elevation than Cedargap soils, and they have less chert in the control section. Secesh soils also are at a slightly higher elevation and have less chert in the control section. They have an argillic horizon.

Typical pedon of Cedargap silt loam, from an area of Cedargap-Secesh silt loams, 0 to 3 percent slopes, 1,850 feet south and 360 feet east of the northwest corner of sec. 33, T. 27 N., R. 21 W.

A1—0 to 12 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 5/2) dry; weak very fine and fine granular structure; very friable; many fine roots; 5 percent chert fragments; slightly acid; clear smooth boundary.

A2—12 to 18 inches; dark brown (7.5YR 3/2) cherty silt loam, brown (7.5YR 5/2) dry; weak fine subangular blocky and very fine and fine granular structure; very friable; many fine roots; 15 percent chert fragments; slightly acid; clear smooth boundary.
A3—18 to 42 inches; dark brown (7.5YR 3/2) extremely cherty silt loam, brown (7.5YR 5/2) dry; weak fine and medium granular structure; friable; common fine roots; 85 percent chert fragments; neutral; clear smooth boundary.
C1—42 to 55 inches; very dark brown (10YR 2/2) extremely cherty clay loam; weak fine granular structure; friable; common fine roots; 75 percent chert fragments; neutral; clear smooth boundary.
C2—55 to 65 inches; dark reddish brown (5YR 3/4) very cherty silty clay loam; weak very fine subangular blocky structure; friable; few fine roots; 60 percent chert fragments; neutral; clear smooth boundary.

The depth to bedrock is more than 60 inches. Chert content of the A horizon, to a depth of 12 inches, ranges from 0 to 35 percent. The 12- to 40-inch zone averages 35 to 60 percent chert fragments, but individual horizons range from 15 to 85 percent. The soil is medium acid to neutral.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 through 3. It is silt loam, cherty silt loam, or cherty loam. The C horizon has hue of 10YR, 7.5YR, or 5YR; value of 2 through 5; and chroma of 1 through 4. It is cherty, very cherty, or extremely cherty silt loam, loam, silty clay loam, or clay loam.

Clarksville Series

The Clarksville series consists of deep, somewhat excessively drained soils on uplands. Permeability is moderately rapid. These soils formed in cherty residuum from limestone. Slopes range from 2 to 60 percent.

Clarksville soils commonly are adjacent to Doniphan, Gatewood, Goss, and Ocie soils. Doniphan soils have more clay and less chert than Clarksville soils, and they are upslope. Gatewood and Ocie soils are shallower to bedrock and are downslope. Goss soils have more clay and are in positions on the landscape similar to those of Clarksville soils.

Typical pedon of Clarksville very cherty silt loam, 14 to 20 percent slopes, 1,190 feet west and 1,780 feet north of the southeast corner of sec. 14, T. 25 N., R. 21 W.

A—0 to 2 inches; dark grayish brown (10YR 4/2) very cherty silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; many fine roots; 40 percent chert fragments; very strongly acid; clear smooth boundary.
E—2 to 12 inches; pale brown (10YR 6/3) and yellowish brown (10YR 5/4) very cherty silt loam; weak fine and very fine granular structure; friable; many fine roots; 45 percent chert fragments; very strongly acid; clear smooth boundary.
BE—12 to 17 inches; brown (7.5YR 5/4) very cherty silt loam; weak very fine subangular blocky and fine and medium granular structure; friable; common fine roots; 60 percent chert fragments; very strongly acid; gradual smooth boundary.
Bt1—17 to 26 inches; strong brown (7.5YR 5/6) extremely cherty silty clay loam; weak very fine subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; 70 percent chert fragments; very strongly acid; gradual smooth boundary.
Bt2—26 to 36 inches; mixed red (2.5YR 5/6), light brown (7.5YR 6/4), and reddish yellow (7.5YR 6/6) extremely cherty silty clay loam; moderate medium and coarse subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; 70 percent chert fragments; very strongly acid; clear smooth boundary.
Bt3—36 to 45 inches; mixed dark red (2.5YR 3/6), red (2.5YR 4/6), and light reddish brown (5YR 6/4) extremely cherty clay; moderate fine angular blocky and subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; 75 percent chert fragments; very strongly acid; gradual wavy boundary.
Bt4—45 to 60 inches; red (2.5YR 4/6) very cherty clay; moderate fine angular blocky structure; firm; few fine roots; common faint clay films on faces of peds; 60 percent chert fragments; very strongly acid.

Thickness of the solum ranges from about 60 to more than 100 inches. The chert content of the A horizon ranges from about 20 percent to 60 percent or more. Chert content of the Bt horizon ranges from 40 to 85 percent. The chert is mostly fine, but part of it ranges to coarse. Some areas are stony.

The A or Ap horizon has hue of 10YR, value of 4 through 6, and chroma of 2 through 4. The A horizon is cherty or very cherty silt loam. Reaction is strongly acid or very strongly acid if not recently limed.

The E horizon has hue of 10YR, value of 4 through 6, and chroma of 2 through 4. The Bt horizon has hue of 7.5YR through 2.5YR, value of 3 through 6, and chroma of 4 through 6. The upper part of the Bt horizon is very cherty or extremely cherty silt loam or very cherty or extremely cherty silty clay loam. The lower part is very cherty silty clay loam, very cherty silty clay, or very cherty or extremely cherty clay. Reaction is medium acid through very strongly acid.

Creldon Series

The Creldon series consists of deep, moderately well drained soils that have a fragipan. These soils are on uplands. They formed in a thin layer of loess or other

silty material and cherty residuum from limestone. Permeability is moderate above the fragipan and slow in the fragipan. Slopes range from 1 to 4 percent.

Creldon soils commonly are adjacent to Tonti and Wilderness soils. Tonti soils have a lighter colored surface layer and more chert than Creldon soils, and they are in positions on the landscape similar to those of Creldon soils. Wilderness soils have a lighter colored surface layer and are cherty throughout. They are downslope from Creldon soils.

Typical pedon of Creldon silt loam, 1 to 4 percent slopes, 1,980 feet north and 910 feet east of the southwest corner of sec. 29, T. 27 N., R. 24 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many fine roots; medium acid; abrupt smooth boundary.

Bt1—7 to 14 inches; dark brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; friable; many fine roots; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—14 to 19 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—19 to 24 inches; mixed reddish brown (5YR 5/4), yellowish red (5YR 5/6), and dark yellowish brown (10YR 4/4) silty clay; moderate medium subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; 5 percent chert fragments; very strongly acid; clear smooth boundary.

Btx1—24 to 33 inches; mottled yellowish red (5YR 5/6), strong brown (7.5YR 5/8), light brownish gray (10YR 6/2), dark gray (10YR 4/1), and red (2.5YR 4/6) silty clay loam; moderate thick platy structure; very firm; brittle; few distinct clay films on faces of peds; 10 percent chert fragments; extremely acid; gradual smooth boundary.

2Btx2—33 to 44 inches; mottled yellowish red (5YR 5/6), strong brown (7.5YR 5/8), light brownish gray (10YR 6/2), dark gray (10YR 4/1), and red (2.5YR 4/6) very cherty silty clay loam; massive; very firm; brittle; few faint clay films along polygonal cracks; 60 percent chert fragments; extremely acid; clear wavy boundary.

2Bt4—44 to 61 inches; dark red (2.5YR 3/6) very cherty clay; common fine distinct reddish brown (5YR 5/3) mottles; moderate very fine and fine angular blocky structure; firm; common faint clay films on faces of peds; 45 percent chert fragments; extremely acid.

Thickness of the solum and depth to bedrock are more than 60 inches. Chert content is 0 to 15 percent in the A horizon.

The A or Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 2 or 3. It is neutral to very strongly acid. The Bt horizon has hue of 10YR through 5YR, value of 3 through 5, and chroma of 3 through 6. In some pedons, mottles that have chroma of 2 or less and value of 4 or more are in the upper 10 inches of the Bt horizon. The Bt horizon dominantly is silty clay loam or silty clay, but in some pedons it is cherty silty clay loam or cherty silty clay. It is slightly acid to very strongly acid. The fragipan has mixed colors of red, brown, and gray, any one of which may dominate. It is very cherty or cherty silt loam, very cherty or cherty silty clay loam, silt loam, or silty clay loam. The fragipan is very strongly acid or extremely acid. The 2Bt4 horizon has hue of 2.5YR, value of 3 or 4, and chroma of 6 through 8. Mottles in shades of gray or brown are common. The 2Bt4 horizon is very cherty clay, cherty silty clay, or cherty silty clay loam. The 2Bt horizon is medium acid to extremely acid.

Doniphan Series

The Doniphan series consists of deep, well drained soils on uplands. Permeability is moderate. These soils formed in cherty and clayey residuum from limestone and shale. Slopes range from 2 to 14 percent.

Doniphan soils commonly are adjacent to Clarksville and Wilderness soils. Clarksville soils have more chert than Doniphan soils and are downslope. Wilderness soils have a fragipan and are upslope from Doniphan soils.

Typical pedon of Doniphan cherty silt loam, from an area of Doniphan-Clarksville cherty silt loams, 2 to 14 percent slopes, 530 feet south and 265 feet east of the northwest corner of sec. 13, T. 25 N., R. 20 W.

A—0 to 3 inches; dark grayish brown (10YR 4/2) cherty silt loam, pale brown (10YR 6/3) dry; moderate very fine and fine granular structure; very friable; many fine and common medium roots; 35 percent chert fragments; strongly acid; clear smooth boundary.

E—3 to 7 inches; pale brown (10YR 6/3) and light yellowish brown (10YR 6/4) cherty silt loam; weak very fine and fine granular structure; friable; common fine and medium roots; 35 percent chert fragments; very strongly acid; clear wavy boundary.

B/E—7 to 13 inches; yellowish red (5YR 5/6) and strong brown (7.5YR 5/6) cherty silty clay loam (Bt), and light yellowish brown (10YR 6/4) cherty silt loam (E); moderate very fine and fine subangular blocky structure; friable; common fine and medium roots; 30 percent chert; very strongly acid; clear wavy boundary.

Bt1—13 to 25 inches; red (2.5YR 4/6) clay; common fine distinct strong brown (7.5YR 5/6) mottles; moderate very fine and fine subangular and angular blocky structure; firm; common fine roots; few faint clay

films on faces of peds; 10 percent chert fragments; very strongly acid; clear wavy boundary.

Bt2—25 to 32 inches; dark red (2.5YR 3/6) clay; many medium prominent strong brown (7.5YR 5/6) and few fine prominent pinkish gray (7.5YR 7/2) mottles; moderate very fine and fine angular blocky structure; firm; few fine roots; few faint clay films on faces of peds; 5 percent chert fragments; very strongly acid; clear wavy boundary.

Bt3—32 to 60 inches; mottled dark red (2.5YR 3/6), pale brown (10YR 6/3), strong brown (7.5YR 5/6), and light gray (10YR 7/2) clay; moderate very fine and fine angular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; 20 percent chert fragments in pockets; very strongly acid.

Thickness of the solum and depth to bedrock are more than 60 inches.

The A or Ap horizon has hue of 10YR, value of 2 through 4, and chroma of 1 through 3. The E horizon has hue of 10YR, value of 4 through 6, and chroma of 3 or 4. Chert content of the A and E horizons ranges from 25 to 75 percent. These horizons are very strongly acid through slightly acid.

The upper part of the Bt horizon has hue of 2.5YR through 7.5YR, value of 3 through 5, and chroma of 4 through 8. The lower part has hue of 2.5YR through 10YR, value of 3 through 7, and chroma of 4 through 8; there are few or common gray mottles that are neutral or have chroma of 1. The Bt horizon ranges from strongly acid to extremely acid.

Gasconade Series

The Gasconade series consists of shallow, somewhat excessively drained soils on uplands. Permeability is moderately slow. These soils formed in clayey residuum from dolomite or limestone. Slopes range from 9 to 65 percent.

Gasconade soils commonly are adjacent to Bardley, Gatewood, Goss, and Ocie soils. These soils are deeper to bedrock than Gasconade soils, and they are on smoother parts of the landscape.

Typical pedon of Gasconade flaggy silty clay, from an area of Gasconade-Rock outcrop complex, 9 to 65 percent slopes, 2,500 feet east and 660 feet north of the southwest corner of sec. 30, T. 25 N., R. 19 W.

A—0 to 10 inches; very dark brown (10YR 2/2) flaggy silty clay, very dark grayish brown (10YR 3/2) dry; moderate very fine and fine subangular blocky structure; firm; many fine roots; 15 percent chert fragments and 20 percent dolomite fragments; neutral; clear smooth boundary.

Bw—10 to 17 inches; very dark grayish brown (2.5Y 3/2) flaggy silty clay; moderate very fine and fine subangular and angular blocky structure; firm; common fine roots; 40 percent dolomite fragments and 25 percent chert fragments; neutral; abrupt irregular boundary.

R—17 inches; hard dolomite.

Thickness of the solum and depth to bedrock are 4 to 20 inches. Dolomite and chert fragments are on the surface and throughout the profile. Coarse fragment content of the control section is 35 to 70 percent. Reaction ranges from slightly acid to neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silty clay loam, silty clay, or clay loam or their flaggy analogues. The Bw horizon has hue of 7.5YR through 2.5Y, value of 3 or 4, and chroma of 2 through 4. It is flaggy silty clay, clay loam, or clay. Some pedons do not have a B horizon.

Gatewood Series

The Gatewood series consists of moderately deep, moderately well drained soils on uplands. Permeability is slow. These soils formed in residuum from dolomite or limestone. Slopes range from 2 to 35 percent.

Gatewood soils are similar to Bardley soils, and they commonly are adjacent to Bardley, Gasconade, and Ocie soils. Bardley soils have a redder subsoil than Gatewood soils. Gasconade soils are shallower to bedrock, and Ocie soils are deeper to bedrock. All of these soils are in positions on the landscape similar to those of Gatewood soils.

Typical pedon of Gatewood cherty silt loam, from an area of Gatewood-Ocie-Rock outcrop complex, 9 to 35 percent slopes, 2,450 feet north and 790 feet west of the southeast corner of sec. 32, T. 26 N., R. 20 W.

A—0 to 2 inches; dark grayish brown (10YR 4/2) cherty silt loam, light brownish gray (10YR 6/2) dry; moderate fine and medium granular structure; friable; many very fine and fine roots; 30 percent chert fragments; medium acid; clear smooth boundary.

E—2 to 6 inches; brown (10YR 5/3) very cherty silt loam; weak fine and medium granular structure; friable; many fine roots; 60 percent chert fragments; slightly acid; clear smooth boundary.

Bt1—6 to 14 inches; strong brown (7.5YR 5/6) clay; weak and moderate fine angular blocky structure; firm; common fine roots; few faint clay films on faces of peds; 10 percent chert fragments; strongly acid; gradual smooth boundary.

Bt2—14 to 29 inches; yellowish brown (10YR 5/6) clay; weak medium and coarse angular blocky structure; very firm; few fine roots; common faint clay films on faces of peds; 10 percent chert fragments; slightly acid; clear smooth boundary.

Bt3—29 to 35 inches; mixed brownish yellow (10YR 6/6), strong brown (7.5YR 5/6), red (2.5YR 5/6),

and reddish brown (2.5YR 5/4) channery clay; massive parting to weak medium subangular blocky and angular blocky structure; very firm; few fine roots; common faint clay films on faces of peds; 35 percent dolomite fragments; neutral; clear wavy boundary.

R—35 inches; hard dolomite.

Thickness of the solum and depth to bedrock range from 20 to 40 inches. The chert content of the A and E horizons ranges from 5 to 75 percent. The Bt horizon commonly is as much as 15 percent chert and dolomite fragments in the upper part and as much as 50 percent in the lower part.

The A horizon has hue of 10YR, value of 2 through 6, and chroma of 1 through 4. It typically is cherty silt loam, but very cherty silt loam and silt loam are within the range. The A horizon ranges from strongly acid through slightly acid.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 through 6, and chroma of 4 through 8. It is clay, silty clay, cherty clay, or cherty silty clay. Mottles of high chroma are common in the lower part of the B horizon. Reaction is strongly acid or medium acid but ranges to neutral in the lower part.

Goss Series

The Goss series consists of deep, well drained soils on uplands. Permeability is moderate. These soils formed in cherty residuum from limestone. Slopes range from 2 to 20 percent.

Goss soils commonly are adjacent to Clarksville, Gasconade, Peridge, and Wilderness soils. Clarksville soils have less clay in the B horizon than Goss soils and are downslope. Gasconade soils are shallower to bedrock and are on the breaks. Peridge soils contain less chert and are on high terraces and uplands. Wilderness soils have a fragipan and are upslope from Goss soils.

Typical pedon of Goss cherty silt loam, 9 to 14 percent slopes, 2,510 feet east and 190 feet south of the northwest corner of sec. 16, T. 26 N., R. 21 W.

Ap—0 to 6 inches; dark brown (7.5YR 4/2) cherty silt loam, pinkish gray (7.5YR 6/2) dry; moderate fine granular structure; very friable; many fine roots; 25 percent chert fragments; slightly acid; abrupt smooth boundary.

BA—6 to 10 inches; brown (7.5YR 5/4) cherty silty clay loam; moderate very fine subangular blocky structure; friable; many fine roots; 30 percent chert fragments; slightly acid; clear smooth boundary.

Bt1—10 to 19 inches; yellowish red (5YR 5/6) very cherty silty clay loam; few fine prominent light yellowish brown (10YR 6/4) mottles; moderate very fine subangular blocky structure; firm; many fine roots; few faint clay films on faces of peds; 45 percent chert fragments; neutral; clear smooth boundary.

Bt2—19 to 26 inches; red (2.5YR 4/8) very cherty silty clay; few fine prominent light yellowish brown (10YR 6/4) mottles; moderate fine and very fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; 40 percent chert fragments; slightly acid; gradual wavy boundary.

Bt3—26 to 62 inches; dark reddish brown (2.5YR 3/4) cherty clay; moderate fine and very fine angular blocky structure; very firm; few fine roots; common faint clay films on faces of peds; 35 percent chert fragments; very strongly acid.

Thickness of the solum and depth to bedrock are more than 60 inches. Most areas contain significant amounts of both fine and coarse chert in the profile. Some areas are stony.

The Ap horizon has hue of 10YR or 7.5YR, value of 4 through 6, and chroma of 2 through 4. The A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 through 4. Chert content in the A horizon and the E horizon, if present, ranges from 10 to 35 percent. Reaction is medium acid through neutral.

The upper part of the Bt horizon has hue of 7.5YR, 5YR, or 2.5YR; value of 4 or 5; and chroma of 4 through 8. The lower part has hue of 2.5YR or 10R, value of 3 or 4, and chroma of 4 through 8. Few to common mottles are in the Bt horizon of most pedons. The Bt horizon is cherty or very cherty silty clay loam through cherty or very cherty clay. Both the clay content and the chert content of the control zone are each more than 35 percent. Below the control zone the average chert content is 30 to 80 percent, but individual subhorizons can be relatively chert free. The Bt horizon ranges from neutral to medium acid in the upper part and from very strongly acid to medium acid in the lower part.

Huntington Series

The Huntington series consists of deep, well drained soils on flood plains. Permeability is moderate. These soils formed in alluvium that washed from soils formed in limestone, dolomite, sandstone, and shale residuum. Slopes range from 0 to 3 percent.

Huntington soils commonly are adjacent to Cedargap and Peridge soils. Cedargap soils are cumulic. They have more chert or gravel than Huntington soils, and they are lower on the flood plain. Peridge soils have an argillic horizon and are on high stream terraces and uplands.

Typical pedon in an area of Huntington silt loam, 0 to 3 percent slopes, 1,520 feet west and 140 feet south of the northeast corner of sec. 13, T. 27 N., R. 23 W.

Ap—0 to 11 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak very fine and fine

granular structure; very friable; common very fine roots; medium acid; clear smooth boundary.

BA—11 to 22 inches; brown (7.5YR 4/4) silt loam; weak very fine and fine subangular blocky structure; friable; few fine and very fine roots; medium acid; gradual smooth boundary.

Bw1—22 to 37 inches; brown (7.5YR 4/4) silt loam; weak fine subangular blocky structure; friable; few fine and very fine roots; medium acid; gradual smooth boundary.

Bw2—37 to 51 inches; brown (7.5YR 4/4) silt loam; weak fine and medium subangular blocky structure; friable; few fine and very fine roots; trace of fine sand; medium acid; gradual smooth boundary.

Bw3—51 to 62 inches; brown (7.5YR 4/4) silt loam; weak fine subangular blocky structure; friable; trace of fine sand and chert fragments or gravel; medium acid.

Thickness of the solum and depth to gravelly layers are more than 40 inches and commonly more than 60 inches. Coarse fragment content ranges from about 1 to 5 percent. The soil ranges from neutral through medium acid.

The Ap or A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 2 or 3. It is silt loam or loam. Many pedons have a BA horizon that has hue of 10YR or 7.5YR, value of 4, and chroma dominantly of 3 or 4 but ranging to 2 in some pedons. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam.

The C horizon has colors similar to those of the B horizon. In some pedons it has mottles of low chroma. The C horizon is silt loam, loam, silty clay loam, or clay loam. Some pedons have thin strata of fine gravel and sand.

Needleye Series

The Needleye series consists of deep, moderately well drained soils that have a fragipan. These soils are on uplands. They formed in a thin layer of loess or silty material and the underlying cherty residuum from limestone. Permeability is slow in the fragipan. Slopes range from 1 to 3 percent.

The Needleye soils in this county are taxadjuncts to the Needleye series because they have less chert in the fragipan. This difference, however, does not significantly alter the usefulness or behavior of the soils.

Needleye soils are similar to Captina and Tonti soils and are adjacent to Captina, Tonti, and Wilderness soils. Captina soils do not have mottles of 2 chroma or less in the upper 10 inches of the argillic horizon. Tonti and Wilderness soils have more chert than Needleye soils. Wilderness soils are on the sides and tops of ridges.

Typical pedon of Needleye silt loam from an area of Captina-Needleye silt loams, 1 to 3 percent slopes, 1,385 feet east and 265 feet north of the southwest corner of sec. 35, T. 28 N., R. 21 W.

A—0 to 6 inches; grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) and light brownish gray (10YR 6/2) dry; moderate very fine and fine granular structure; friable; many fine roots; very strongly acid; clear smooth boundary.

E—6 to 9 inches; pale brown (10YR 6/3) and light yellowish brown (10YR 6/4) silt loam; moderate very fine and fine granular structure; friable; many fine roots; very strongly acid; clear smooth boundary.

Bt1—9 to 17 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct grayish brown (10YR 5/2) mottles; moderate very fine and fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—17 to 28 inches; mottled light brownish gray (10YR 6/2), pale brown (10YR 6/3), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) silty clay loam; weak fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; very strongly acid; abrupt smooth boundary.

2Btx1—28 to 38 inches; mottled yellowish red (5YR 5/6), red (2.5YR 4/6), light gray (10YR 7/2), and light brownish gray (10YR 6/2) silty clay loam; moderate medium platy structure parting to moderate fine subangular blocky; very firm; brittle; common faint clay films on faces of peds; extremely acid; diffuse smooth boundary.

2Btx2—38 to 60 inches; mottled red (2.5YR 4/6), brown (7.5YR 5/4), yellowish red (5YR 5/6), light gray (10YR 7/2), light brownish gray (10YR 6/2), and dark grayish brown (10YR 4/2) silty clay loam; moderate medium platy structure parting to moderate medium angular blocky; extremely firm; brittle; common faint clay films on faces of peds; extremely acid; clear wavy boundary.

2Bt3—60 to 70 inches; dark red (2.5YR 3/6) very cherty clay; moderate fine angular blocky structure; firm; common faint clay films on faces of peds; 60 percent chert fragments; extremely acid.

Thickness of the solum and depth to bedrock are more than 60 inches. The A horizon and the upper part of the B horizon are less than 5 percent chert. The lower part of the B horizon above the fragipan is 0 to 20 percent chert. Chert content in the fragipan ranges from 0 to 20 percent. Below the fragipan, the average chert content ranges from 10 to more than 60 percent.

The A horizon has hue of 10YR or 7.5YR, value of 3 through 5, and chroma of 2 through 4. The A horizon is medium acid to very strongly acid if it has not been limed.

The upper part of the Bt horizon above the fragipan has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 through 6. Mottles that have value of 4 or more and chroma of 2 or less are in the upper 10 inches of the argillic horizon. The lower part of this horizon has mottles that have hue of 10YR or 7.5YR, value of 4 through 6, and chroma of 2 through 6. The Bt horizon typically is silty clay loam, but some pedons are silty clay in some subhorizons. The Bt horizon is strongly acid or very strongly acid.

The fragipan has mixed colors of red, gray, and brown; any one of these may dominate. It is silty clay loam or silt loam or their cherty analogues. The fragipan is very strongly acid or extremely acid.

The 2Bt horizon has hue of 2.5YR or 5YR, value of 3 through 5, and chroma of 4 through 6. Distinct or prominent gray or brown mottles are common. The 2Bt horizon dominantly is very cherty or cherty clay but ranges to very cherty or cherty silty clay or very cherty or cherty silty clay loam. Some pedons do not have a 2Bt horizon.

Ocie Series

The Ocie series consists of deep, moderately well drained soils on uplands. Permeability is moderate in the upper part of the profile and slow in the lower part. These soils formed in residuum from dolomite or limestone. Slopes range from 2 to 35 percent.

Ocie soils commonly are adjacent to Bardley, Gasconade, and Gatewood soils. These soils are in positions on the landscape similar to those of Ocie soils, but they are shallower to bedrock.

Typical pedon of Ocie cherty silt loam, 2 to 9 percent slopes, 1,000 feet east and 1,584 feet south of the northwest corner of sec. 15, T. 25 N., R. 19 W.

A—0 to 5 inches; dark grayish brown (10YR 4/2) cherty silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; many medium roots; 20 percent chert fragments; slightly acid; clear smooth boundary.

E—5 to 11 inches; pale brown (10YR 6/3) cherty silt loam; weak fine subangular blocky structure parting to weak fine granular; friable; many medium roots and pores; 15 percent chert fragments; medium acid; gradual smooth boundary.

Bt1—11 to 17 inches; light yellowish brown (10YR 6/4) and reddish yellow (7.5YR 6/6) very cherty silt loam; weak medium subangular blocky structure; friable; many fine roots; few faint clay films on faces of peds; 50 percent chert fragments; medium acid; clear wavy boundary.

Bt2—17 to 24 inches; light yellowish brown (10YR 6/4) cherty clay loam; common fine prominent red (2.5YR 4/8) and yellowish red (5YR 5/8) mottles; moderate fine subangular blocky structure; friable; common fine roots and pores; few faint clay films on faces of peds; 35 percent chert fragments and 5 percent sandstone cobbles; strongly acid; clear wavy boundary.

2Bt3—24 to 30 inches; strong brown (7.5YR 5/8) and yellowish brown (10YR 5/6) cherty clay; common medium and few fine prominent red (2.5YR /48) mottles; moderate medium subangular blocky structure; firm; many medium roots and pores; many faint clay films on faces of peds; 20 percent chert fragments; very strongly acid; gradual wavy boundary.

2Bt4—30 to 41 inches; strong brown (7.5YR 5/6) cherty clay; few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine roots and pores; many faint clay films on faces of peds; common dark stains of iron and manganese oxides; 15 percent chert fragments; strongly acid; gradual wavy boundary.

2Bt5—41 to 56 inches; mixed yellowish brown (10YR 5/8), yellowish red (5YR 4/6), yellow (10YR 7/6), and reddish yellow (7.5YR 6/8) clay; weak medium angular blocky structure; very firm; few medium roots and pores; few faint clay films on faces of peds; 10 percent chert and sandstone fragments; medium acid; abrupt wavy boundary.

R—56 inches; hard dolomite.

Solum thickness and depth to bedrock range from 40 to 60 inches. Some pedons have a C or Cr horizon. Coarse fragment content of the Bt horizon averages 35 to 50 percent and includes both chert and sandstone. The soil is very strongly acid through slightly acid.

The A1 or Ap horizon has value of 3 through 5 and chroma of 2 through 4. The E horizon has value of 4 through 6 and chroma of 3 through 6. These horizons are silt loam, loam, or fine sandy loam and commonly are cherty.

The Bt1 horizon has hue of 10YR through 5YR, value of 3 through 6, and chroma of 4 through 8. It is very cherty silt loam, cherty silt loam, very cherty loam, or cherty loam. The Bt2 horizon has hue of 2.5YR through 10YR, value of 4 through 7, and chroma of 4 through 8. It is cherty clay loam, very cherty clay loam, cherty silty clay loam, or very cherty silty clay loam. The 2Bt horizon has hue of 2.5YR through 10YR, value of 4 through 7, and chroma of 2 through 8. It is cherty clay or clay.

Peridge Series

The Peridge series consists of deep, well drained soils on high stream terraces and uplands. Permeability is moderate. These soils formed in a thin layer of loess and the underlying residuum from limestone or dolomite. Slopes range from 2 to 5 percent.

Peridge soils commonly are adjacent to Clarksville, Gatewood, Goss, Ocie, and Huntington soils. Clarksville soils have more chert than Peridge soils. Gatewood and

Ocie soils are shallower to bedrock and have more clay, and Goss soils have more chert and clay. Huntington soils do not have an argillic horizon. Clarksville, Gatewood, Goss, and Ocie soils are upslope on uplands. Huntington soils are on flood plains.

Typical pedon in an area of Peridge silt loam, 2 to 5 percent slopes, 2,110 feet west of the southeast corner of sec. 36, T. 27 N., R. 22 W.

Ap—0 to 5 inches; brown (7.5YR 4/4) silt loam, light brown (7.5YR 6/4) dry; moderate very fine and fine granular structure; very friable; many fine roots; 5 percent chert fragments; slightly acid; clear smooth boundary.

Bt1—5 to 15 inches; yellowish red (5YR 4/6) silty clay loam; moderate and strong very fine and fine subangular blocky structure; friable; many fine roots; few faint clay films on faces of peds; 5 percent chert fragments; few fine dark concretions of iron and manganese oxides; medium acid; gradual smooth boundary.

Bt2—15 to 25 inches; red (2.5YR 4/6) silty clay loam; moderate fine and medium subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; 5 percent chert fragments; few fine dark concretions of iron and manganese oxides; medium acid; gradual smooth boundary.

Bt3—25 to 39 inches; mixed red (2.5YR 4/6), yellowish red (5YR 4/6), and pale brown (10YR 6/3) silty clay loam; weak fine and medium subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; few chert fragments; few fine dark concretions of iron and manganese oxides; strongly acid; diffuse smooth boundary.

Bt4—39 to 64 inches; mixed yellowish red (5YR 4/6), red (2.5YR 4/6), and pale brown (10YR 6/3) silty clay loam; weak coarse subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; few chert fragments; few fine dark concretions of iron and manganese oxides; strongly acid.

Thickness of the solum ranges from 80 to 100 inches or more. Content of chert fragments ranges from 0 to 10 percent above a depth of 40 inches and from 0 to 35 percent below a depth of 40 inches.

The Ap or A1 horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 through 4. It is strongly acid through neutral. Some pedons have a silt loam BA horizon. The Bt horizon has hue of 7.5YR through 2.5YR, value of 3 through 5, and chroma of 4 through 6. The upper part is silty clay loam. The lower part is silty clay loam or silty clay or their cherty analogues. The Bt horizon is very strongly acid through medium acid in the upper part and strongly acid or very strongly acid in the lower part.

Secesh Series

The Secesh series consists of deep, well drained soils on flood plains. Permeability is moderate. These soils formed in 2 to 3 feet of silty alluvial material and the underlying cherty residuum from limestone, dolomite, and sandstone. Slopes range from 1 to 3 percent.

Secesh soils commonly are adjacent to Cedargap and Huntington soils. Cedargap soils are in slightly lower positions than Secesh soils and have more chert. Huntington soils are in similar positions and have less chert.

Typical pedon of Secesh silt loam, from an area of Cedargap-Secesh silt loams, 0 to 3 percent slopes, 1,915 feet east and 1,320 feet south of the northwest corner of sec. 11, T. 26 N., R. 21 W.

Ap—0 to 10 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate very fine granular structure; very friable; many fine roots; 5 percent chert fragments; medium acid; clear smooth boundary.

BA—10 to 15 inches; brown (7.5YR 5/4) silt loam; weak and moderate very fine subangular blocky structure; friable; many fine roots; 12 percent chert fragments; medium acid; clear smooth boundary.

Bt1—15 to 35 inches; reddish brown (5YR 4/4) silty clay loam; weak and moderate medium and fine subangular blocky structure; friable; few fine roots; few faint clay films on the faces of peds; 8 percent chert fragments; very strongly acid; clear wavy boundary.

2Bt2—35 to 50 inches; reddish brown (5YR 4/4) extremely cherty clay loam; common medium prominent light brown (7.5YR 6/4) mottles; weak medium and fine subangular blocky structure; firm; few faint clay films on faces of peds; 75 percent chert fragments; very strongly acid; clear wavy boundary.

2Bt3—50 to 55 inches; mixed reddish brown (5YR 4/4), red (2.5YR 4/6), and brown (7.5YR 5/4) extremely cherty clay loam; moderate fine and medium subangular blocky structure; firm; few faint clay films on faces of peds; 70 percent chert fragments; very strongly acid; clear wavy boundary.

2Bt4—55 to 65 inches; mixed yellowish red (5YR 4/6), red (2.5YR 4/6), and brown (7.5YR 5/4) extremely cherty clay loam; weak very fine and fine subangular blocky structure; firm; few faint clay films on faces of peds; 75 percent chert fragments; very strongly acid.

Thickness of the solum ranges from 40 to 60 inches and commonly is more than 60 inches. The A horizon is slightly acid to strongly acid. The Bt horizon is medium acid to very strongly acid.

The A or Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. It is dominantly silt loam but

ranges to loam. The Bt and 2Bt horizons have hue of 7.5YR, 5YR, or 2.5YR; value of 4 through 6; and chroma of 4 or 6. Chert content ranges from 8 to 75 percent.

Tonti Series

The Tonti series consists of deep, moderately well drained soils that have a fragipan. These soils are on uplands and high terraces. They formed in a thin layer of loess or other silty material and the underlying cherty residuum from limestone. Permeability is moderate above the fragipan and slow in the fragipan. Slopes range from 2 to 5 percent.

Tonti soils are similar to Captina soils and commonly are adjacent to Captina, Peridge, and Wilderness soils. Captina soils have less chert than Tonti soils. Peridge soils do not have a fragipan, and they are downslope on high terraces. Wilderness soils have more chert than Tonti soils, and they are on higher ridges and lower side slopes.

Typical pedon of Tonti silt loam, 2 to 5 percent slopes, 2,500 feet south and 1,720 feet east of the northwest corner of sec. 8, T. 27 N., R. 21 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak very fine and fine granular structure; friable; many very fine and fine roots; trace of fine chert fragments; medium acid; clear smooth boundary.

BA—7 to 12 inches; yellowish brown (10YR 5/4) silt loam; weak very fine subangular blocky structure; friable; many very fine and fine roots; 3 percent chert fragments; strongly acid; clear smooth boundary.

Bt1—12 to 18 inches; brown (7.5YR 5/4) silty clay loam; moderate very fine and fine subangular blocky structure; friable; many very fine and fine roots; few faint clay films on faces of peds; 5 percent chert fragments; strongly acid; clear wavy boundary.

Bt2—18 to 22 inches; yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) cherty silty clay loam; few fine distinct grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure; friable; common very fine and fine roots; few faint clay films on faces of peds; 25 percent chert fragments; strongly acid; clear wavy boundary.

2Btx—22 to 40 inches; mixed strong brown (7.5YR 5/6), light yellowish brown (10YR 6/4), and pale brown (10YR 6/3) very cherty silty clay loam; weak very fine subangular blocky structure; very firm; brittle; few faint clay films on faces of peds; 45 percent chert fragments; very strongly acid; clear wavy boundary.

2Bt3—40 to 62 inches; red (2.5YR 4/6) extremely cherty clay; common medium distinct reddish brown (5YR 5/3) and common medium prominent pinkish gray (7.5YR 6/2) mottles; moderate very fine angular blocky structure; firm; many faint clay films on faces of peds; 65 percent chert fragments; very strongly acid.

Thickness of the solum and depth to bedrock are more than 60 inches. Depth to the fragipan ranges from 15 to 24 inches. The soil ranges from extremely acid to strongly acid throughout unless limed.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or loam or their cherty analogues. Some pedons have an E horizon.

The BA horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It typically is silt loam, but the range includes loam, cherty silt loam, or cherty loam. The Bt1 and Bt2 horizons have hue of 10YR or 7.5YR, value of 5, and chroma of 4 or 6. They are silt loam, cherty silt loam, and cherty silty clay loam and range from 10 to 25 percent chert.

The 2Btx horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 through 6. It is cherty or very cherty silt loam or cherty or very cherty silty clay loam and ranges from 20 to 70 percent chert.

The 2Bt3 horizon has hue of 2.5YR, value of 3 or 4, and chroma of 4 or 6. Mottles are in shades of gray, yellow, and brown. The 2Bt3 horizon is clay or silty clay and their cherty or very cherty analogues.

Wilderness Series

The Wilderness series consists of deep, moderately well drained soils that have a fragipan. These soils are on uplands. They formed in cherty residuum from limestone. Permeability is moderate above the fragipan and slow in the fragipan. Slopes range from 2 to 9 percent.

The Wilderness soils in this county are taxadjuncts to the Wilderness series because they have lower base saturation. This difference, however, does not significantly alter the usefulness or behavior of the soils.

Wilderness soils commonly are adjacent to Clarksville, Goss, and Tonti soils. Clarksville and Goss soils do not have a fragipan and commonly are downslope. Tonti soils have less chert than Wilderness soils and are upslope.

Typical pedon of Wilderness cherty silt loam, 2 to 9 percent slopes, 1,320 feet south and 324 feet west of the northeast corner of sec. 7, T. 27 N., R. 22 W.

A—0 to 1 inch; dark grayish brown (10YR 4/2) cherty silt loam, light brownish gray (10YR 6/2) dry; moderate very fine granular structure; very friable; many fine roots; 15 percent chert fragments; neutral; clear smooth boundary.

E—1 inch to 5 inches; brown (10YR 4/3) cherty silt loam; weak fine and very fine granular structure; very friable; many fine roots; 20 percent chert fragments; medium acid; clear smooth boundary.

Bt1—5 to 8 inches; yellowish brown (10YR 5/4) cherty silty clay loam; moderate and weak very fine subangular blocky structure parting to medium and coarse granular; friable; many fine roots; few faint clay films on faces of peds; 35 percent chert fragments; very strongly acid; clear smooth boundary.

Bt2—8 to 16 inches; brown (7.5YR 5/4) extremely cherty silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; 65 percent chert fragments; very strongly acid; clear wavy boundary.

Ex—16 to 23 inches; mixed pale brown (10YR 6/3), yellowish brown (10YR 5/6), and brown (7.5YR 4/4) extremely cherty silt loam; weak thick platy structure; very firm; brittle; 70 percent chert fragments; very strongly acid; clear wavy boundary.

Btx—23 to 31 inches; mixed light brownish gray (10YR 6/2), brown (7.5YR 4/4), light reddish brown (5YR 6/4), and red (2.5YR 4/6) extremely cherty silty clay loam; very firm; weak thick platy structure; very firm; brittle; few distinct clay films on faces of peds; 75 percent chert fragments; very strongly acid; gradual wavy boundary.

2Bt3—31 to 40 inches; red (2.5YR 4/6) very cherty silty clay; few fine distinct red (2.5YR 4/8) and common medium prominent light brownish gray (10YR 6/2) and pale brown (10YR 6/3) mottles; weak and moderate fine angular blocky structure; firm; common faint clay films on faces of peds; 60 percent chert fragments; very strongly acid; gradual wavy boundary.

2Bt4—40 to 60 inches; dark red (2.5YR 3/6) very cherty clay; few fine distinct red (2.5YR 4/8) mottles, few fine prominent strong brown (7.5YR 5/8) mottles, and common fine prominent pinkish gray (7.5YR 6/2) mottles; moderate fine angular blocky structure; firm; common faint clay films on faces of peds; 40 percent chert fragments; very strongly acid.

Depth to bedrock and thickness of the solum are more than 60 inches.

The Ap or A horizon has hue of 10YR, value of 3 through 5, and chroma of 2 or 3. The E horizon, if present, has hue of 10YR, value of 4 through 6, and chroma of 2 through 4.

The Bt horizon has hue of 10YR, 7.5YR, or 5YR; value of 4 or 5; and chroma of 4 through 6. It is cherty, very cherty, or extremely cherty silty clay loam and cherty, very cherty, or extremely cherty silt loam. The chert content of the Bt horizon ranges from 35 to 65 percent. The Bt horizon ranges from medium acid through extremely acid. The Ex and Btx horizons are mottled red, gray, and brown; any one of these may be the dominant color. They are cherty, very cherty, or extremely cherty silt loam or silty clay loam. The chert content ranges from 40 to 85 percent. Reaction is very strongly acid or extremely acid.

Geology and Physiography

John W. Whitfield, geologist, Missouri Department of Natural Resources, prepared this section.

Christian County is situated on the Springfield Plateau and the Salem Plateau. It is mostly on the Springfield Plateau, but the southeastern part of the county and a small area in the south-central part are on the Salem Plateau. The county is underlain by sedimentary rock ranging from Ordovician age through the Burlington-Keokuk limestone. Isolated outcrops of Pennsylvanian sandstone are in the northwestern corner of the county.

From oldest to youngest, the geologic formations in Christian County are Cotter Dolomite, Bachelor Formation, Compton Formation, Northview Formation, Pierson Formation, Reed Springs and Elsey Formations, Burlington-Keokuk limestone, and Pennsylvanian sandstone.

The Cotter Formation is thin to medium bedded dolomite that has thin beds of chert and sandstone. Cotter Dolomite varies in thickness but averages 200 feet. Outcrops of this formation are on the rugged hills and in valleys in the southeastern and south-central parts of Christian County. Stream and creek floors are covered with chert cobbles and gravel that have eroded away from the Cotter Dolomite. Outcrops of sandstone generally are less than 1 foot but may range to several feet in thickness. These outcroppings are generally unnoticeable, except as scattered sandstone boulders mixed with the thin cherty soils that cover the wooded hillsides. A thick sandstone unit called Swan Creek is in the central part of the Cotter Dolomite. Swan Creek furnishes small amounts of ground water that recharge many of the springs in the valleys of southern Christian County.

The Bachelor Formation overlies the Cotter Dolomite. This formation is small shaly sandstone that is generally less than 6 inches thick. Although exposures are rare because of the thinness of the formation, this shaly sandstone covers a considerable area. The Bachelor Formation contributes very little to the soil and topography of Christian County.

The Compton Formation overlies the Bachelor Formation. It consists of fine grained, light gray limestone that ranges from 10 to 20 feet in thickness. This limestone is thin to medium bedded and contains small fossil fragments. The Compton Formation outcrops on the rugged hillslopes of southeastern Christian County but is rare in other parts of the county. This formation creates small stairsteplike bluffs on the hillsides, but otherwise contributes very little to the soil or topography of Christian County.

The Northview Formation consists of green silty shale ranging from 5 to 20 feet in thickness. Several greenish tan siltstone beds interbedded with shale are in the upper part of this formation. Boulders and fragments that have broken away from the siltstone beds have wormlike holes and caudagalli or "rooster tail" cast on the stone surface. Outcrops of the Northview Formation are fragmented shale that have a distinct greenish tan color. This shale tends to break down to form a sticky clay soil that has very slow permeability. The shale can be excavated by a backhoe or bulldozer, but the siltstone beds may be difficult to excavate. Drilling and blasting may be necessary to remove the thicker beds. Because the shale acts as a barrier against the downward percolation of ground water, many springs occur at the top of the Northview Formation. Ground water that collects on top of the shale will move laterally and resurface as a spring in a gully or valley intersecting the shale.

The Pierson Formation generally crops out as medium to massive bedded, brown dolomitic limestone in Christian County. The contact between the underlying Northview Formation and the Pierson Formation is indistinct because of the gradual lithologic change from shale to dolomite. The Pierson Formation ranges from 10 to 35 feet in thickness. Outcrops occur on the lower hillslopes that border Finley Creek and the James River. In the southeastern part of the county the Pierson Formation is near the tops of rugged wooded hills in the Ozarks region.

The Reed Springs and Elsey Formations are separate formations and are distinct in Missouri Stratigraphic Nomenclature; however, because of lithologic similarity and a scarcity of data about the extent of the Reed Springs Formation in southern Christian County, these two formations are combined in this report. These formations are made up of thin, alternating layers of limestone and chert (fig. 24). The chert layers usually are in the form of nodules or wavy beds of chert between thin layers of limestone. The beds are estimated to be 40 to 60 percent chert. The combined Reed Springs-Elsey Formation is approximately 150 feet thick in Christian County. Outcrops are common in all parts of the county but mostly occur on the hillslopes bordering the James and Finley River valleys. Because the chert content is high, soils that formed from the residuum of the Reed Springs and Elsey Formations are dominated by chert gravel and boulders. Soil thickness ranges from less than 1 foot to more than 15 feet.

The Burlington and Keokuk Formations are separate formations, but because of geologic similarities in southwestern Missouri, they are considered as a single unit. The Burlington-Keokuk limestone is light gray,, coarse crystalline limestone that ranges from 100 to 150 feet in thickness. This formation is thin to massive bedded and has discontinuous bands of chert and isolated chert nodules.

The very gravelly soils that formed from the residuum of the Reed Springs and Elsey Formations and the Burlington and Keokuk Formations are a major influence on soil conditions and, to a lesser extent, on the topographic development of Christian County.

Sinkholes, losing streams, and caves commonly occur throughout Christian County. The topography formed over these features is called karst. Karst topography is the result of weathering in the underlying, calcium-rich limestone. Over millions of years the ground water that has percolated through fractures in the limestone has slowly dissolved and enlarged the fractures until the bedrock is a network of tunnels and caves. In Christian County large karst areas occur around Billings, Clever, Nixa, and Sparta. These towns are situated on flat to gently rolling uplands underlain by thick, stony soil and caverns of limestone. The various sinkholes and losing streams are scattered over the karst areas on uplands and act as conduits to the underlying ground water table. Surface water that enters these sinkholes or losing streams percolates downward through the permeable soils and bedrock openings and recharges the ground water aquifer. Because of this infiltration, the numerous water wells and springs that obtain water from the ground water aquifer can be affected by the presence of contaminants in a sink or losing stream.

Any type of development that is to be located in a karst area should be carefully planned and engineered to prevent the contaminants that originate in the development from affecting the underlying ground water supplies. Poorly planned livestock facilities, waste disposal lagoons, landfills, or closely spaced septic tanks placed on karst areas can have a rapid and drastic effect on the ground water aquifer. Pollution of individual farm wells from agricultural activity will occur unless the wells are properly cased and sealed. Each site needs to be specially investigated regarding rock, soil, hydrology, and karst characteristics.

Hydrology

John W. Whitfield, geologist, Missouri Department of Natural Resources, prepared this section.

Exposed bedrock formations in Christian County produce small amounts of ground water. The Burlington-Keokuk, Elsey, Reed Springs, and Pierson Formations produce from 1 to 20 gallons of water per minute in shallow wells.

The Northview Formation is silty shale that acts as an aquitard and retards or slows the downward percolation of ground water. Silty shales do not produce ground water, but numerous springs occur at the outcrop of the Northview Formation.

The Compton-Bachelor and Cotter Formations do not add to the ground water supplies. The Swan Creek sandstone in the central part of the Cotter Formation has

Figure 24.—An exposure of Elsey limestone and chert in the Goss-Clarksville association.

produced small amounts of ground water, but its quality has deteriorated because of contamination of the poorly constructed and cased wells.

Dolomites in the Cambrian-Ordovician age formations are the major sources for ground water supplies in Christian County. Several cities, industries, and large mobile home parks in Christian County obtain water from wells that are more than 1,000 feet deep. These wells produce from 300 to more than 1,000 gallons of water per minute.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Division of Planning and Policy Development. 1976. Missouri statewide comprehensive outdoor recreation plan (SCORP). Dep. Nat. Resour.

(4) Missouri Bureau of Outdoor Recreation. 1974. NACD nationwide outdoor recreation inventory. Mo. Bur. Outdr. Rec.

(5) Nagel, Werner O. 1970 Conservation contrasts. Mo. Dep. Conserv.

(6) State Inter-Agency Council for Outdoor Recreation. 1980. Missouri statewide comprehensive outdoor recreation plan (SCORP). Dep. Nat. Resour.

(7) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962.]

(8) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(9) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay,

less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods.

Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as

protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high

1.75 to 2.5 .... high
More than 2.5 .... very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10

square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, EB, or AB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-79 at Springfield, Missouri]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	41.5	20.7	31.1	69	-7	14	1.62	0.64	2.44	4	4.4
February---	46.7	25.6	36.2	74	-1	19	2.11	1.09	3.00	5	3.8
March------	55.6	33.3	44.5	83	8	84	3.43	1.62	4.97	7	4.0
April------	67.8	44.3	56.1	87	23	214	4.07	2.34	5.59	7	.5
May--------	76.1	53.5	64.8	90	33	459	4.39	2.52	6.04	8	.0
June-------	84.5	62.2	73.4	96	44	702	4.69	2.08	6.92	7	.0
July-------	89.1	66.4	77.8	101	49	862	3.68	1.33	5.63	6	.0
August-----	88.5	64.9	76.7	100	49	828	2.89	1.18	4.32	5	.0
September--	80.9	57.7	69.3	96	38	579	4.33	1.41	6.71	7	.0
October----	70.2	46.1	58.2	90	26	277	3.17	1.32	4.73	5	.0
November---	55.5	34.1	44.8	78	11	40	2.95	1.06	4.51	5	2.1
December---	45.8	26.1	36.0	72	-2	10	2.57	1.13	3.80	5	2.6
Yearly:											
Average--	66.9	44.6	55.7	---	---	---	---	---	---	---	---
Extreme--	---	---	---	102	-8	---	---	---	---	---	---
Total----	---	---	---	---	---	4,088	39.90	32.02	47.36	71	17.4

[1] A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-79 at Springfield, Missouri]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 6	April 19	May 3
2 years in 10 later than--	April 1	April 15	April 28
5 years in 10 later than--	March 22	April 7	April 18
First freezing temperature in fall:			
1 year in 10 earlier than--	October 24	October 18	October 9
2 years in 10 earlier than--	October 29	October 23	October 14
5 years in 10 earlier than--	November 8	November 1	October 22

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-79 at Springfield, Missouri]

Probability	Length of the growing season if daily minimum temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	204	189	168
8 years in 10	213	195	174
5 years in 10	230	207	187
2 years in 10	247	220	199
1 year in 10	256	226	206

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
5C	Wilderness cherty silt loam, 2 to 9 percent slopes	30,096	8.3
6B	Creldon silt loam, 1 to 4 percent slopes	1,350	0.4
8B	Captina-Needleye silt loams, 1 to 3 percent slopes	5,782	1.6
21B	Peridge silt loam, 2 to 5 percent slopes	7,981	2.2
22C	Ocie cherty silt loam, 2 to 9 percent slopes	3,453	1.0
23B	Bolivar fine sandy loam, 2 to 5 percent slopes	2,255	0.6
24F	Gatewood-Ocie-Rock outcrop complex, 9 to 35 percent slopes	56,204	15.6
25D	Ocie-Bardley-Gatewood complex, 2 to 14 percent slopes	9,642	2.7
27D	Bolivar stony fine sandy loam, 2 to 14 percent slopes	372	0.1
35D	Doniphan-Clarksville cherty silt loams, 2 to 14 percent slopes	33,325	9.2
43C	Goss cherty silt loam, 2 to 9 percent slopes	43,945	12.2
43D	Goss cherty silt loam, 9 to 14 percent slopes	26,349	7.3
44G	Goss-Gasconade complex, 2 to 50 percent slopes	5,374	1.5
45D	Clarksville very cherty silt loam, 5 to 14 percent slopes	6,202	1.7
45E	Clarksville very cherty silt loam, 14 to 20 percent slopes	11,224	3.1
45F	Clarksville very cherty silt loam, 20 to 35 percent slopes	21,504	6.0
45G	Clarksville very cherty silt loam, 35 to 60 percent slopes	20,623	5.7
55A	Huntington silt loam, 0 to 3 percent slopes	7,668	2.1
81B	Tonti silt loam, 2 to 5 percent slopes	35,009	9.7
83G	Gasconade-Rock outcrop complex, 9 to 65 percent slopes	15,105	4.2
92A	Cedargap-Secesh silt loams, 0 to 3 percent slopes	9,400	2.6
93A	Cedargap cherty silt loam, 0 to 3 percent slopes	8,074	2.2
94	Pits-Dumps complex	68	*
	Total	361,005	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils are not considered prime farmland. If a soil is prime farmland under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
6B	Creldon silt loam, 1 to 4 percent slopes
8B	Captina-Needleye silt loams, 1 to 3 percent slopes
21B	Peridge silt loam, 2 to 5 percent slopes
23B	Bolivar fine sandy loam, 2 to 5 percent slopes
55A	Huntington silt loam, 0 to 3 percent slopes
92A	Cedargap-Secesh silt loams, 0 to 3 percent slopes (where protected from flooding)
93A	Cedargap cherty silt loam, 0 to 3 percent slopes (where protected from flooding)

TABLE 6.--CAPABILITY SUBCLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield figure indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Capability subclass	Corn	Winter wheat	Soybeans	Grass-legume hay	Alfalfa hay	Tall fescue
		Bu	Bu	Bu	Ton	Ton	AUM*
5C-------------- Wilderness	IVs	---	20	---	2.0	2.5	4.0
6B-------------- Creldon	IIe	75	35	30	3.0	4.0	6.0
8B-------------- Captina-Needleye	IIe	75	35	30	3.0	3.5	6.0
21B------------- Peridge	IIe	100	45	30	3.8	5.0	6.5
22C------------- Ocie	IVs	---	30	---	2.5	3.0	5.0
23B------------- Bolivar	IIIe	60	32	20	2.0	2.5	4.5
24F------------- Gatewood-Ocie-Rock outcrop	VIIs	---	---	---	---	---	4.0
25D------------- Ocie-Bardley-Gatewood	VIs	---	---	---	2.1	2.0	5.5
27D------------- Bolivar	VIs	---	---	---	---	---	4.0
35D------------- Doniphan-Clarksville	VIs	---	30	---	2.5	3.0	5.0
43C------------- Goss	IVs	---	30	25	2.5	3.0	5.0
43D------------- Goss	VIs	---	---	---	2.0	2.5	4.5
44G------------- Goss-Gasconade	VIIs	---	---	---	---	---	3.7
45D------------- Clarksville	VIs	---	25	---	1.7	2.5	4.0
45E, 45F-------- Clarksville	VIIs	---	---	---	---	---	2.6
45G------------- Clarksville	VIIs	---	---	---	---	---	2.0
55A------------- Huntington	IIw	130	50	45	4.0	6.0	7.0
81B------------- Tonti	IIIe	80	40	30	3.0	3.5	5.5
83G------------- Gasconade-Rock outcrop	VIIs	---	---	---	---	---	1.6
92A------------- Cedargap-Secesh	IIs	85	35	30	3.0	4.0	6.0

See footnote at end of table.

TABLE 6.--CAPABILITY SUBCLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Capability subclass	Corn	Winter wheat	Soybeans	Grass-legume hay	Alfalfa hay	Tall fescue
		Bu	Bu	Bu	Ton	Ton	AUM*
93A--------------- Cedargap	IIIs	70	30	25	2.5	3.5	5.0
94**------------- Pits-Dumps	---	---	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
5C Wilderness	4d	Slight	Slight	Moderate	Slight	White oak Black oak	55 ---	White oak, shortleaf pine, black oak.
6B Creldon	---	--------	--------	--------	--------		---	Pin oak, black oak, shortleaf pine, white oak, sweetgum, green ash.
8B*:								
Captina	4d	Slight	Slight	Moderate	Slight	Shortleaf pine Eastern redcedar Black locust Black walnut	60 40 --- ---	Shortleaf pine, eastern redcedar, black walnut, black locust, northern red oak.
Needleye	4d	Slight	Slight	Moderate	Slight	White oak Black oak Shortleaf pine	60 --- ---	White oak, shortleaf pine, black oak.
21B Peridge	3o	Slight	Slight	Slight	Slight	Shortleaf pine Northern red oak Eastern redcedar Black walnut White oak White ash Black cherry Black locust	70 70 50 --- 66 --- --- ---	Shortleaf pine, loblolly pine, black walnut, black locust, northern red oak, white ash.
22C Ocie	4f	Slight	Moderate	Slight	Slight	White oak Black oak Northern red oak	57 58 ---	Shortleaf pine, northern red oak.
23B Bolivar	4o	Slight	Slight	Slight	Slight	White oak Black oak Northern red oak Black walnut	57 --- --- ---	White oak, green ash, shortleaf pine.
24F*:								
Gatewood	5c	Moderate	Moderate	Severe	Slight	White oak Eastern redcedar Post oak Black oak	45 --- --- ---	Eastern redcedar, shortleaf pine.
Ocie	4f	Moderate	Moderate	Slight	Slight	White oak Black oak Northern red oak	57 58 ---	Shortleaf pine, northern red oak.
Rock outcrop.								
25D*:								
Ocie	4o	Slight	Slight	Slight	Slight	White oak Black oak Northern red oak	57 58 ---	Shortleaf pine, northern red oak.
Bardley	5c	Slight	Moderate	Severe	Slight	Post oak	45	Shortleaf pine, eastern redcedar, white oak, black oak.
Gatewood	5c	Slight	Slight	Severe	Slight	White oak Eastern redcedar Post oak Black oak	45 --- --- ---	Eastern redcedar, shortleaf pine.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
27D------------------ Bolivar	4x	Slight	Moderate	Slight	Slight	White oak------------	57	White oak, white ash, shortleaf pine.
						Post oak-------------	---	
						Northern red oak-----	---	
						Black walnut---------	---	
35D*:								
Doniphan------------	4f	Slight	Moderate	Slight	Slight	White oak------------	60	Shortleaf pine, white oak, white ash, black oak, sugar maple.
						Shortleaf pine-------	60	
Clarksville---------	4f	Slight	Moderate	Moderate	Slight	White oak------------	55	White oak, shortleaf pine, white ash.
						Shortleaf pine-------	---	
43C, 43D------------ Goss	4f	Slight	Moderate	Slight	Slight	White oak------------	60	White ash, shortleaf pine, black oak.
						Shortleaf pine-------	---	
						Post oak-------------	---	
						Blackjack oak--------	---	
						Black oak------------	---	
44G*:								
Goss----------------	4f	Severe	Severe	Severe	Slight	White oak------------	60	White ash, black oak, shortleaf pine.
						Shortleaf pine-------	---	
						Post oak-------------	---	
						Blackjack oak--------	---	
						Black oak------------	---	
Gasconade-----------	5d	Severe	Severe	Severe	Slight	Eastern redcedar-----	30	Eastern redcedar, shortleaf pine.
						Chinkapin oak--------	---	
						White ash------------	---	
						Sugar maple----------	---	
						Mockernut hickory----	---	
						Post oak-------------	---	
						Blackjack oak--------	---	
45D------------------ Clarksville	4f	Slight	Moderate	Moderate	Slight	White oak------------	55	White oak, shortleaf pine, green ash.
						Shortleaf pine-------	---	
45E, 45F------------ Clarksville	4f	Slight	Moderate	Moderate	Slight	White oak------------	55	White oak, shortleaf pine, green ash.
						Shortleaf pine-------	---	
45G------------------ Clarksville	4f	Moderate	Severe	Severe	Slight	White oak------------	55	White oak, shortleaf pine, green ash.
						Shortleaf pine-------	---	
55A------------------ Huntington	1o	Slight	Slight	Slight	Moderate	Yellow-poplar--------	96	Yellow-poplar, black walnut, northern red oak, eastern white pine.
						Northern red oak-----	85	
81B------------------ Tonti	4d	Slight	Slight	Moderate	Slight	Shortleaf pine-------	60	Shortleaf pine, eastern redcedar.
						Northern red oak-----	65	
						Black locust---------	---	
						Black walnut---------	---	
						Eastern redcedar-----	40	
83G*:								
Gasconade-----------	5d	Moderate	Severe	Moderate	Slight	Eastern redcedar-----	30	Eastern redcedar, shortleaf pine.
						Chinkapin oak--------	---	
						White ash------------	---	
						Sugar maple----------	---	
						Mockernut hickory----	---	
						Post oak-------------	---	
						Blackjack oak--------	---	
Rock outcrop.								
92A*:								
Cedargap------------	3f	Slight	Slight	Moderate	Moderate	Black oak------------	66	Black oak, shortleaf pine.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	
92A*: Secesh------------	4o	Slight	Slight	Slight	Slight	White oak-----------	60	Shortleaf pine, American sycamore, white oak.
						Shortleaf pine------	---	
						American sycamore---	---	
						Black walnut--------	---	
						Black oak-----------	---	
93A---------------- Cedargap	3f	Slight	Slight	Moderate	Moderate	Black oak-----------	66	Black oak, shortleaf pine.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
5C Wilderness	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive	Honeylocust, Austrian pine, hackberry, eastern redcedar, green ash, bur oak, Russian-olive.	Siberian elm	---
6B Creldon	Lilac	Autumn-olive, Manchurian crabapple, Amur honeysuckle, Amur maple.	Hackberry, eastern redcedar, Austrian pine, green ash, jack pine, Russian-olive.	Honeylocust	---
8B*:					
Captina	Lilac	Autumn-olive, Manchurian crab-apple, Amur honeysuckle, Amur maple.	Hackberry, eastern redcedar, Austrian pine, green ash, jack pine, Russian-olive.	Honeylocust	---
Needleye	Lilac	Manchurian crabapple, Amur honeysuckle, Amur maple, autumn-olive.	Eastern redcedar, Austrian pine, hackberry, green ash, jack pine, Russian-olive.	Honeylocust	---
21B. Peridge	---	Lilac, Amur honeysuckle, autumn-olive, Amur maple.	Eastern redcedar, hackberry, Russian-olive.	Norway spruce, eastern white pine, honey-locust, green ash, pin oak.	---
22C Ocie	Lilac, Amur honeysuckle, fragrant sumac.	Autumn-olive	Russian-olive, green ash, honeylocust, bur oak, eastern redcedar, hackberry, Austrian pine.	Siberian elm	---
23B Bolivar	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive	Green ash, hackberry, bur oak, Russian-olive, Austrian pine, eastern redcedar, honeylocust.	Siberian elm, honeylocust.	---
24F*:					
Gatewood	Lilac, Amur honeysuckle, fragrant sumac.	Autumn-olive	Austrian pine, Russian-olive, eastern redcedar, green ash, bur oak, honeylocust, hackberry.	Siberian elm	---
Ocie	Lilac, Amur honeysuckle, fragrant sumac.	Autumn-olive	Russian-olive, green ash, honeylocust, bur oak, eastern redcedar, hackberry, Austrian pine.	Siberian elm	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
24F*: Rock outcrop.					
25D*: Ocie	Lilac, Amur honeysuckle, fragrant sumac.	Autumn-olive	Russian-olive, green ash, honeylocust, bur oak, eastern redcedar, hackberry, Austrian pine.	Siberian elm	---
25D*: Bardley	Lilac, fragrant sumac, Amur honeysuckle.	Autumn-olive	Russian-olive, hackberry, eastern redcedar, bur oak, green ash, Austrian pine, honeylocust.	Siberian elm	---
Gatewood	Lilac, Amur honeysuckle, fragrant sumac.	Autumn-olive	Austrian pine, Russian-olive, eastern redcedar, green ash, hackberry, bur oak, honeylocust.	Siberian elm	---
27D Bolivar	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive	Eastern redcedar, Russian-olive, hackberry, bur oak, green ash, Austrian pine, honeylocust.	Siberian elm	---
35D*: Doniphan	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive	Austrian pine, honeylocust, eastern redcedar, hackberry, green ash, bur oak, Russian-olive.	Siberian elm	---
Clarksville	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive	Eastern redcedar, Austrian pine, honeylocust, hackberry, green ash, bur oak, Russian-olive.	Siberian elm	---
43C, 43D Goss	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive	Russian-olive, Austrian pine, eastern redcedar, bur oak, hackberry, green ash, honeylocust.	Siberian elm	---
44G*: Goss	Amur honeyscukle, lilac, fragrant sumac.	Autumn-olive	Russian-olive, Austrian pine, eastern redcedar, bur oak, hackberry, green ash, honeylocust.	Siberian elm	---
Gasconade.					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
45D, 45E, 45F, 45G Clarksville	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive	Eastern redcedar, Austrian pine, honeylocust, hackberry, green ash, bur oak, Russian-olive.	Siberian elm	---
55A. Huntington	---	Amur honeysuckle, Amur maple, Autumn-olive.	Eastern redcedar	Austrian pine, eastern white pine, hackberry, green ash, honeylocust, pin oak.	Eastern cottonwood.
81B. Tonti	Lilac	Amur maple, Autumn-olive, Amur honeysuckle, Manchurian crabapple.	Russian-olive, Austrian pine, eastern redcedar, jack pine, hackberry, green ash.	Honeylocust	---
83G*: Gasconade.					
Rock outcrop.					
92A*: Cedargap	---	Amur maple, Amur honeysuckle, autumn-olive, lilac.	Eastern redcedar	Hackberry, Austrian pine, eastern white pine, green ash, honeylocust, pin oak.	Eastern cottonwood.
Secesh	---	Autumn-olive, Amur honeysuckle, Amur maple, lilac.	Eastern redcedar	Austrian pine, honeylocust, pin oak, eastern white pine, hackberry, green ash.	Eastern cottonwood.
93A Cedargap	---	Amur maple, Amur honeysuckle, autumn-olive, lilac.	Eastern redcedar	Hackberry, Austrian pine, eastern white pine, green ash, honeylocust, pin oak.	Eastern cottonwood.
94*: Pits.					
Dumps.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
5C Wilderness	Severe: wetness.	Moderate: wetness, small stones.	Severe: small stones, wetness.	Moderate: wetness.	Severe: droughty.
6B Creldon	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Moderate: wetness.
8B*:					
Captina	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
Needleye	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Moderate: wetness, droughty.
21B Peridge	Slight	Slight	Moderate: slope.	Slight	Slight.
22C Ocie	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Severe: erodes easily.	Moderate: large stones.
23B Bolivar	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
24F*:					
Gatewood	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Moderate: slope.	Severe: small stones, slope.
Ocie	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Rock outcrop.					
25D*:					
Ocie	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: large stones, slope.
Bardley	Severe: small stones.	Severe: small stones.	Severe: small stones.	Slight	Severe: small stones.
Gatewood	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: large stones, slope.
27D Bolivar	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: large stones.	Severe: large stones.
35D*:					
Doniphan	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Moderate: large stones.	Severe: small stones, large stones.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
35D*: Clarksville	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones.
43C Goss	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Severe: droughty.
43D Goss	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Severe: droughty.
44G*: Goss	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: droughty, slope.
Gasconade	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: large stones, slope.	Severe: large stones, slope, thin layer.
45D Clarksville	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe. small stones.	Severe: small stones.
45E, 45F Clarksville	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones, slope.
45G Clarksville	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones, slope.
55A Huntington	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
81B Tonti*	Moderate: percs slowly, wetness, small stones.	Moderate: wetness, percs slowly, small stones.	Moderate: percs slowly, slope, wetness.	Severe: erodes easily.	Moderate: wetness, small stones, droughty.
83G*: Gasconade	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: large stones, slope.	Severe: large stones, slope, thin layer.
Rock outcrop.					
92A*: Cedargap	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Secesh	Severe: flooding.	Slight	Moderate: small stones, flooding.	Slight	Moderate: large stones, flooding.
93A Cedargap	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones, flooding.	Severe: small stones.	Severe: small stones, flooding.
94*: Pits.					
Dumps.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
5C Wilderness	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Poor	Poor	Very poor.
6B Creldon	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8B*:										
Captina	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Needleye	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
21B Peridge	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
22C Ocie	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
23B Bolivar	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
24F*:										
Gatewood	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Ocie	Very poor.	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Rock outcrop.										
25D*:										
Ocie	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Bardley	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Gatewood	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
27D Bolivar	Poor	Poor	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
35D*:										
Doniphan	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Clarksville	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
43C, 43D Goss	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
44G*:										
Goss	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Gasconade	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
45D, 45E, 45F Clarksville	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
45G: Clarksville	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
55A: Huntington	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
81B: Tonti	Fair	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Very poor.
83G*:										
Gasconade	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										
92A*:										
Cedargap	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Secesh	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
93A: Cedargap	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
94*:										
Pits.										
Dumps.										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
5C----------------- Wilderness	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Severe: droughty.
6B----------------- Creldon	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
8B*:						
Captina-----------	Moderate: too clayey, wetness.	Moderate: wetness.	Severe: shrink-swell, wetness.	Moderate: wetness.	Severe: low strength.	Slight.
Needleye----------	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness, droughty.
21B---------------- Peridge	Moderate: too clayey.	Slight----------	Slight----------	Slight----------	Severe: low strength.	Slight.
22C---------------- Ocie	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: large stones.
23B---------------- Bolivar	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: thin layer.
24F*:						
Gatewood----------	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: small stones, slope.
Ocie--------------	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
Rock outcrop.						
25D*:						
Ocie--------------	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: large stones, slope.
Bardley-----------	Severe: depth to rock.	Moderate: shrink-swell, depth to rock, slope.	Severe: depth to rock.	Severe: slope.	Severe: low strength.	Severe: small stones.
Gatewood----------	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: large stones, slope.
27D---------------- Bolivar	Moderate: depth to rock, large stones, slope.	Moderate: shrink-swell, slope, large stones.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, frost action.	Severe: large stones.
35D*:						
Doniphan----------	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Severe: small stones.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
35D*:						
Clarksville------	Moderate: too clayey, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Severe: small stones.
43C--------------- Goss	Moderate: too clayey, large stones.	Moderate: shrink-swell, large stones.	Moderate: shrink-swell, large stones.	Moderate: shrink-swell, slope, large stones.	Moderate: low strength, frost action.	Severe: droughty.
43D--------------- Goss	Moderate: too clayey, large stones, slope.	Moderate: shrink-swell, slope, large stones.	Moderate: slope, shrink-swell, large stones.	Severe: slope.	Moderate: low strength, slope, frost action.	Severe: droughty.
44G*:						
Goss-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Gasconade--------	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, slope, thin layer.
45D--------------- Clarksville	Moderate: too clayey, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Severe: small stones.
45E, 45F, 45G----- Clarksville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope.
55A--------------- Huntington	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Moderate: flooding.
81B--------------- Tonti	Severe: wetness.	Moderate: wetness.	Severe: shrink-swell, wetness.	Moderate: slope, wetness.	Moderate: low strength, wetness.	Moderate: wetness, small stones, droughty.
83G*:						
Gasconade--------	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, slope, thin layer.
Rock outcrop.						
92A*:						
Cedargap---------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Secesh-----------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: large stones, flooding.
93A--------------- Cedargap	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: small stones, flooding.
94*:						
Pits.						
Dumps.						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
5C: Wilderness	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, small stones.
6B: Creldon	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack, small stones.
8B*:					
Captina	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Needleye	Severe: percs slowly, wetness.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: small stones, too clayey, hard to pack.
21B: Peridge	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey, thin layer.
22C: Ocie	Severe: wetness, percs slowly.	Severe: wetness.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
23B: Bolivar	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
24F*:					
Gatewood	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Ocie	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Rock outcrop.					
25D*:					
Ocie	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.
Bardley	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Gatewood	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
27D: Bolivar	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
35D*:					
Doniphan-----------	Moderate: percs slowly, slope.	Severe: slope.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
Clarksville--------	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too clayey.	Severe: seepage.	Poor: too clayey, small stones.
43C---------------- Goss	Moderate: percs slowly, large stones.	Severe: seepage.	Severe: too clayey, large stones.	Severe: seepage.	Poor: too clayey, small stones.
43D---------------- Goss	Moderate: percs slowly, slope, large stones.	Severe: seepage, slope.	Severe: too clayey, large stones.	Severe: seepage.	Poor: too clayey, small stones.
44G*:					
Goss---------------	Severe: slope.	Severe: seepage, slope.	Severe: slope, too clayey, large stones.	Severe: seepage, slope.	Poor: too clayey, small stones, slope.
Gasconade----------	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, large stones.
45D---------------- Clarksville	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too clayey.	Severe: seepage.	Poor: too clayey, small stones.
45E, 45F, 45G------- Clarksville	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: seepage, slope.	Poor: too clayey, small stones, slope.
55A---------------- Huntington	Severe: flooding.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Good.
81B---------------- Tonti	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Moderate: wetness.	Poor: hard to pack, too clayey.
83G*:					
Gasconade----------	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, large stones.
Rock outcrop.					
92A*:					
Cedargap-----------	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Poor: small stones.
Secesh-------------	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Poor: small stones.
93A---------------- Cedargap	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Poor: small stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
94*:					
Pits.					
Dumps.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
5C-------------------- Wilderness	Fair: large stones, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
6B-------------------- Creldon	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
8B*:				
Captina---------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Needleye--------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
21B------------------- Peridge	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
22C------------------- Ocie	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
23B------------------- Bolivar	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
24F*:				
Gatewood--------------	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Ocie------------------	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Rock outcrop.				
25D*:				
Ocie------------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Bardley---------------	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Gatewood--------------	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
27D------------------- Bolivar	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
35D*:				
Doniphan--------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
35D*:				
Clarksville	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
43C, 43D Goss	Fair: low strength, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
44G*:				
Goss	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Gasconade	Poor: area reclaim, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
45D Clarksville	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
45E, 45F Clarksville	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
45G Clarksville	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
55A Huntington	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
81B Tonti	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
83G*:				
Gasconade	Poor: area reclaim, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
Rock outcrop.				
92A*:				
Cedargap	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Secesh	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
93A Cedargap	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
94*:				
Pits.				
Dumps.				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways
5C Wilderness	Moderate: slope, seepage.	Moderate: large stones, wetness.	Large stones, wetness.	Large stones, wetness.
6B Creldon	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Large stones, erodes easily.	Erodes easily, rooting depth.
8B*:				
Captina	Moderate: seepage.	Moderate: hard to pack, wetness.	Rooting depth, wetness, erodes easily.	Erodes easily, rooting depth, percs slowly.
Needleye	Moderate: seepage.	Severe: hard to pack.	Wetness, large stones, erodes easily.	Erodes easily, droughty, rooting depth.
21B Peridge	Moderate: seepage.	Moderate: piping.	Erodes easily	Erodes easily.
22C Ocie	Moderate: depth to rock, slope.	Severe: hard to pack.	Large stones, erodes easily.	Large stones, erodes easily.
23B Bolivar	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Depth to rock, soil blowing.	Depth to rock.
24F*:				
Gatewood	Severe: slope.	Severe: hard to pack.	Slope, large stones, depth to rock.	Large stones, slope.
Ocie	Severe: slope.	Severe: hard to pack.	Slope, large stones.	Large stones, slope.
Rock outcrop.				
25D*:				
Ocie	Severe: slope.	Severe: hard to pack.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
Bardley	Severe: slope.	Severe: thin layer.	Depth to rock, slope.	Droughty, slope.
Gatewood	Severe: slope.	Severe: hard to pack.	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
27D Bolivar	Severe: slope.	Severe: thin layer.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
35D*:				
Doniphan	Severe: slope.	Moderate: hard to pack.	Slope	Slope, droughty.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Terraces and diversions	Grassed waterways
35D*: Clarksville	Severe: seepage, slope.	Moderate: large stones.	Slope, large stones.	Large stones, slope, droughty.
43C Goss	Moderate: seepage, slope.	Severe: large stones.	Large stones	Large stones, droughty.
43D Goss	Severe: slope.	Severe: large stones.	Slope, large stones.	Large stones, slope, droughty.
44G*: Goss	Severe: slope.	Severe: large stones.	Slope, large stones.	Large stones, slope, droughty.
Gasconade	Severe: depth to rock, slope.	Severe: large stones.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
45D, 45E, 45F, 45G Clarksville	Severe: seepage, slope.	Moderate: large stones.	Slope, large stones.	Large stones, slope, droughty.
55A Huntington	Moderate: seepage.	Severe: piping.	Favorable	Favorable.
81B Tonti	Moderate: seepage.	Moderate: hard to pack, wetness, large stones.	Rooting depth, wetness, erodes easily.	Erodes easily, rooting depth, percs slowly.
83G*: Gasconade	Severe: depth to rock, slope.	Severe: large stones.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.				
92A*: Cedargap	Severe: seepage.	Severe: seepage.	Large stones	Favorable.
Secesh	Severe: seepage.	Slight	Large stones	Favorable.
93A Cedargap	Severe: seepage.	Severe: seepage.	Large stones	Large stones.
94*: Pits.				
Dumps.				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
5C---------------- Wilderness	0-5	Cherty silt loam	SM-SC, SC, SP-SC, GC	A-1, A-4, A-2-4	0-10	60-85	50-75	20-50	10-40	20-30	5-10
	5-16	Extremely cherty silty clay loam, cherty silty clay loam.	GC, GP-GC, SC, SP-SC	A-6, A-2-6	5-15	40-70	20-60	10-50	10-40	25-40	10-20
	16-31	Extremely cherty silt loam, extremely cherty silty clay loam.	GM-GC, GC, GP-GC	A-1, A-2-4, A-2-6	10-40	30-60	10-45	10-40	5-35	20-40	5-15
	31-60	Very cherty silty clay, very cherty clay.	GC, GP-GC	A-2-6, A-7	10-40	30-70	10-60	10-50	10-45	55-75	35-55
6B---------------- Creldon	0-7	Silt loam--------	ML, CL-ML, CL	A-4	0-5	95-100	95-100	90-100	80-95	15-30	2-10
	7-24	Silty clay loam, silty clay.	CL	A-6, A-7	0-5	80-100	70-100	65-95	60-95	35-45	11-20
	24-44	Very cherty silty clay loam, cherty silt loam, silty clay loam.	CL, GC, SC	A-2, A-6, A-7	0-25	40-80	30-70	25-65	20-60	30-45	11-20
	44-61	Cherty silty clay, cherty clay, very cherty clay.	CL, CH, GC, SC	A-7, A-2-7	0-35	40-80	30-70	25-65	20-60	45-70	25-40
8B*: Captina----------	0-6	Silt loam--------	ML, CL-ML	A-4	0	95-100	90-100	85-100	75-95	<25	NP-7
	6-27	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-100	80-90	20-40	5-20
	27-46	Cherty silty clay loam, cherty silt loam, silty clay loam.	CL-ML, CL, GM-GC, GC	A-4, A-6	5-15	80-95	70-90	65-90	45-90	20-40	5-20
	46-63	Very cherty silty clay loam, very cherty silty clay, extremely cherty clay.	CL, GC, SC	A-6, A-7	5-45	60-95	55-90	45-90	40-85	30-50	15-30
Needleye---------	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	80-90	25-35	7-15
	9-28	Silty clay loam, silty clay, cherty silty clay loam.	CL	A-6, A-7	0-5	85-100	85-100	80-100	70-90	35-45	15-22
	28-60	Cherty silty clay loam, cherty silt loam, silty clay loam.	GC, CL	A-2-6, A-6	5-25	60-90	50-85	50-90	40-90	30-40	11-20
	60-70	Cherty clay, cherty silty clay, very cherty clay.	GC, CH, MH	A-2-7, A-7	5-25	50-75	35-65	30-65	30-60	50-75	25-40
21B--------------- Peridge	0-5	Silt loam--------	ML, CL-ML	A-4	0	95-100	90-100	85-90	80-85	<20	NP-5
	5-39	Silty clay loam, silt loam.	CL	A-6	0	95-100	90-100	85-95	80-95	30-40	11-20
	39-64	Gravelly silty clay loam, silty clay loam.	CL, SC, GC	A-6	0	55-100	50-100	45-90	40-85	30-40	11-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
22C--------------- Ocie	0-11	Cherty silt loam	SC, SM-SC, CL-ML, CL	A-4	0-15	70-85	65-80	55-70	35-55	<25	4-10
	11-17	Very cherty silt loam, very cherty loam, cherty silt loam.	GM, GC, GM-GC	A-2-4, A-2-6	5-20	40-55	35-50	30-45	25-35	20-30	5-15
	17-24	Cherty clay loam, cherty silty clay loam, very cherty clay loam.	GC	A-2, A-6, A-7	10-30	40-55	35-50	30-45	25-40	35-50	15-30
	24-56	Cherty clay, clay	CH	A-7	0-15	70-95	65-90	65-90	60-80	50-70	30-40
	56	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
23B--------------- Bolivar	0-8	Fine sandy loam	ML, SM	A-4	0	100	90-100	70-95	40-55	20-30	NP-5
	8-33	Channery sandy clay loam, loam, sandy clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	5-20	70-95	70-95	60-90	36-60	25-35	5-15
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
24F*: Gatewood--------	0-6	Cherty silt loam	CL, SC, SP-SC	A-4, A-6, A-2	10-30	70-90	20-75	15-70	10-65	25-35	7-15
	6-35	Channery clay, cherty clay, clay.	CH, SC	A-7	5-15	80-95	50-90	40-85	40-85	55-75	30-45
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ocie------------	0-6	Cherty silt loam	CL-ML, CL, SC, SM-SC	A-4	0-15	70-85	65-80	55-70	35-55	<25	4-10
	6-16	Very cherty silt loam, very cherty loam, cherty silt loam.	GM, GC, GM-GC	A-2-4, A-2-6	5-20	40-55	35-50	30-45	25-35	20-30	5-15
	16-25	Cherty clay loam, cherty silty clay loam, very cherty clay loam.	GC	A-2, A-6, A-7	10-30	40-55	35-50	30-45	25-40	35-50	15-30
	25-48	Cherty clay, cherty silty clay, clay.	CH	A-7	0-15	70-95	65-90	65-90	60-80	50-70	30-40
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
25D*: Ocie------------	0-6	Silt loam--------	CL-ML, CL	A-4	0-10	85-100	80-95	70-85	55-70	<25	4-10
	6-15	Very cherty silt loam, very cherty loam, cherty silt loam.	GM, GC, GM-GC	A-2-4, A-2-6	5-20	40-55	35-50	30-45	25-35	20-30	5-15
	15-45	Cherty clay, clay	CH	A-7	0-15	70-95	65-90	65-90	60-80	50-70	30-40
	45	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bardley----------	0-3	Very cherty silt loam.	GC, CL, SC	A-6, A-2	0-15	40-90	30-80	30-70	25-65	30-40	10-20
	3-26	Cherty silty clay, clay, cherty clay.	MH, GM, SM	A-7	0-10	70-95	50-95	50-90	40-85	50-70	20-35
	26-29	Weathered bedrock	---	---	---	---	---	---	---	---	---
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
25D*:											
Gatewood---------	0-4	Silt loam---------	CL	A-4, A-6, A-2	10-30	70-90	20-75	15-70	10-65	25-35	7-15
	4-34	Very cherty silty clay, silty clay, clay, sandy clay.	CH, SC	A-7	5-15	80-95	50-90	40-85	40-85	55-75	30-45
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
27D--------------- Bolivar	0-5	Stony fine sandy loam.	SC, CL-ML, CL, SM-SC	A-4	15-40	80-100	75-95	70-90	40-75	15-25	5-10
	5-10	Sandy clay loam, clay loam.	CL, SC	A-6	0-15	95-100	85-100	70-95	45-80	25-40	11-20
	10-32	Flaggy sandy clay loam, flaggy clay loam, shaly clay loam.	SC, GC	A-6, A-2-6	25-50	60-80	50-75	45-65	25-45	30-40	11-20
	32-59	Weathered bedrock	---	---	---	---	---	---	---	---	---
	59	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
35D*:											
Doniphan---------	0-7	Cherty silt loam	GM, GM-GC, SC, CL-ML	A-2, A-4	5-30	50-80	45-70	45-65	35-60	20-30	2-8
	7-13	Cherty silty clay loam.	CL	A-6	5-30	85-100	85-100	70-85	50-70	30-40	15-25
	13-60	Clay--------------	CH, MH	A-7	0-5	90-100	90-100	85-100	70-95	51-70	25-35
Clarksville------	0-24	Cherty silt loam, very cherty silt loam, extremely cherty silt loam.	GM, GC, SM-SC, GP-GC	A-4, A-2-6, A-1-A	5-20	65-95	60-85	55-80	40-50	20-35	5-10
	24-38	Extremely cherty silty clay loam.	GC, SC, SP-SC, GP-GC	A-2-6, A-6	5-20	30-70	10-60	10-50	5-45	30-40	15-25
	38-78	Very cherty silty clay, very cherty clay.	GC, SC, GP-GC, SP-SC	A-2-7, A-7	5-20	30-70	10-60	10-50	10-45	55-	¯-55
43C, 43D---------- Goss	0-6	Cherty silt loam	ML, CL, CL-ML	A-4	0-10	65-90	65-90	65-90	65-85	20-30	2-8
	6-26	Cherty silty clay loam, very cherty silty clay loam, very cherty silty clay.	GM, GC, GM-GC	A-2	10-40	40-60	35-55	30-50	25-35	20-30	2-8
	26-62	Cherty silty clay loam, cherty silty clay, cherty clay.	GC	A-7	10-45	45-70	40-65	40-50	35-45	50-70	30-40
44G*:											
Goss-------------	0-10	Cherty silt loam	ML, CL, CL-ML	A-4	0-10	65-90	65-90	65-90	65-85	20-30	2-8
	10-25	Very cherty silt loam, cherty silty clay loam.	GM, GC, GM-GC	A-2	10-40	40-60	35-55	30-50	25-35	20-30	2-8
	25-64	Very cherty silty clay loam, cherty silty clay, cherty clay.	GC	A-7	10-45	45-70	40-65	40-50	35-45	50-70	30-40

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
44G*:											
Gasconade	0-3	Flaggy silty clay loam.	CL	A-6	20-70	75-90	70-85	60-75	55-65	30-40	15-25
	3-17	Flaggy silty clay, flaggy clay, very flaggy silty clay.	GC	A-2-7	20-70	45-55	40-50	30-40	20-35	55-65	35-45
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
45D, 45E, 45F, 45G Clarksville	0-17	Very cherty silt loam.	GC, SC, SM-SC, GP-GC	A-2-4, A-2-6, A-1-A	5-20	30-70	10-60	5-50	5-35	20-40	5-15
	17-36	Very cherty silty clay loam, extremely cherty silty clay loam.	GC, SC, SP-SC, GP-GC	A-2-6, A-6	5-20	30-70	10-60	10-50	5-45	30-40	15-25
	36-60	Very cherty silty clay, very cherty clay, extremely cherty clay.	GC, SC, GP-GC, SP-SC	A-2-7, A-7	5-20	30-70	10-60	10-50	10-45	55-75	35-55
55A Huntington	0-11	Silt loam	ML, CL	A-4, A-6	0	95-100	95-100	85-100	60-95	25-40	5-15
	11-62	Silt loam, loam, silty clay loam.	ML, CL	A-4, A-6	0	95-100	95-100	85-100	60-95	25-40	5-15
81B Tonti	0-12	Silt loam	ML	A-4	0-5	75-95	70-90	65-85	60-70	<20	NP-3
	12-22	Cherty silty clay loam, cherty silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0-5	70-90	65-85	60-80	55-75	15-30	5-15
	22-40	Very cherty silty clay loam, very cherty silt loam.	CL-ML, CL, SM-SC, SC	A-4, A-6	5-35	50-75	45-70	40-65	40-60	15-30	5-15
	40-62	Silty clay, cherty clay, extremely cherty clay.	CL, CH, GC	A-6, A-7	0-10	45-70	40-65	40-50	35-45	50-70	30-40
83G*:											
Gasconade	0-10	Flaggy silty clay	CL	A-6	20-70	75-90	70-85	60-75	55-65	30-40	15-25
	10-17	Flaggy silty clay, flaggy clay, very flaggy silty clay.	GC	A-2-7	20-70	45-55	40-50	30-40	20-35	55-65	35-45
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
92A*:											
Cedargap	0-12	Silt loam	ML	A-4	0-5	90-100	85-95	75-95	70-95	25-35	3-9
	12-42	Cherty silt loam, cherty loam, very cherty silt loam, extremely cherty silt loam.	SM, GM	A-1, A-2, A-4	2-15	40-85	20-50	15-45	15-40	25-35	3-9
	42-65	Cherty silt loam, very cherty silty clay loam, extremely cherty clay loam.	GC	A-2-6, A-6	5-20	25-50	20-50	15-45	15-40	30-40	15-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
92A*:											
Secesh----------	0-10	Silt loam--------	ML	A-4	0-10	85-100	80-100	75-95	60-90	20-30	NP-7
	10-35	Silty clay loam, silt loam.	CL, CL-ML	A-4, A-6	0-10	80-100	75-100	70-95	60-90	25-35	5-12
	35-65	Extremely cherty clay loam, very cherty clay loam, cherty sandy clay.	GC, SC, GP-GC, SP-SC	A-6, A-2-6	15-45	40-70	25-65	20-45	10-40	30-40	11-20
93A-------------- Cedargap	0-10	Cherty silt loam	SM, GM	A-1, A-2-4, A-4	2-15	40-85	30-75	20-60	15-50	25-35	3-9
	10-25	Cherty silt loam, cherty loam, very cherty silt loam.	SM, GM	A-1, A-2, A-4	2-15	40-85	20-50	15-45	15-40	25-35	3-9
	25-60	Very cherty silty clay loam, loam, extremely cherty silty clay loam.	GC	A-2-6, A-6	5-20	25-50	20-50	15-45	15-40	30-40	15-25
94*:											
Pits.											
Dumps.											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
5C------------- Wilderness	0-5	18-27	1.20-1.45	2.0-6.0	0.07-0.12	4.5-6.5	Low----------	0.28	2-1	8	.5-2
	5-16	25-35	1.30-1.50	0.6-2.0	0.03-0.10	4.5-6.0	Low----------	0.28			
	16-31	20-35	1.70-2.00	0.06-0.2	---	4.5-5.0	Low----------	0.28			
	31-60	40-70	1.50-1.70	0.6-2.0	---	4.5-5.5	Moderate-----	0.28			
6B------------- Creldon	0-7	15-25	1.20-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.37	4-3	5	1-3
	7-24	35-45	1.30-1.50	0.6-2.0	0.12-0.17	4.5-6.5	Low----------	0.37			
	24-44	25-35	1.50-1.70	0.06-0.2	0.07-0.14	3.6-5.0	Low----------	0.37			
	44-61	35-70	1.10-1.40	0.6-2.0	0.05-0.10	3.6-6.0	Moderate-----	0.37			
8B*:											
Captina---------	0-6	10-25	1.30-1.50	0.6-2.0	0.16-0.24	5.1-6.5	Low----------	0.43	4	5	1-2
	6-27	20-35	1.30-1.50	0.6-2.0	0.16-0.24	5.1-6.5	Low----------	0.37			
	27-46	25-40	1.40-1.60	0.06-0.2	0.04-0.08	3.6-5.5	Low----------	0.32			
	46-63	35-45	1.40-1.60	0.6-2.0	0.02-0.08	3.6-5.5	Moderate-----	0.32			
Needleye--------	0-9	15-25	1.30-1.50	0.6-2.0	0.15-0.22	4.5-6.0	Low----------	0.37	4	6	.5-2
	9-28	25-35	1.50-1.70	0.2-0.6	0.12-0.20	3.6-5.5	Low----------	0.37			
	28-60	20-30	1.65-1.75	0.06-0.2	0.01-0.05	3.6-6.0	Low----------	0.28			
	60-70	40-75	1.10-1.40	0.6-2.0	0.03-0.08	3.6-5.5	Moderate-----	0.28			
21B------------- Peridge	0-5	10-20	1.25-1.45	0.6-2.0	0.16-0.24	4.5-6.0	Low----------	0.37	5	5	1-3
	5-39	20-34	1.25-1.45	0.6-2.0	0.18-0.22	4.5-6.0	Low----------	0.32			
	39-64	30-40	1.25-1.40	0.6-2.0	0.13-0.22	4.5-6.0	Low----------	0.28			
22C------------- Ocie	0-11	10-20	1.10-1.40	0.6-2.0	0.18-0.22	5.1-6.5	Low----------	0.32	4	5	.5-2
	11-17	15-27	1.10-1.35	0.6-2.0	0.12-0.15	4.5-6.0	Low----------	0.32			
	17-24	27-35	1.10-1.30	0.2-0.6	0.09-0.12	4.5-6.0	Moderate-----	0.32			
	24-56	55-80	1.10-1.30	0.06-0.2	0.07-0.10	5.1-6.5	High---------	0.32			
	56	---	---	---	---	---	-------------	----			
23B------------- Bolivar	0-8	12-18	1.20-1.45	2.0-6.0	0.16-0.18	5.1-6.0	Low----------	0.24	4	3	.5-2
	8-33	25-32	1.35-1.55	0.6-2.0	0.09-0.12	4.5-6.0	Low----------	0.32			
	33-60	---	---	---	---	---	-------------	----			
24F*:											
Gatewood--------	0-6	15-25	1.10-1.40	0.6-2.0	0.12-0.17	5.1-6.5	Low----------	0.32	3	8	.5-2
	6-35	60-85	1.10-1.30	0.06-0.2	0.09-0.12	5.1-7.3	High---------	0.32			
	35	---	---	---	---	---	-------------	----			
Ocie------------	0-6	10-20	1.10-1.40	0.6-2.0	0.12-0.17	5.1-6.5	Low----------	0.32	4	8	.5-2
	6-16	15-27	1.10-1.35	0.6-2.0	0.12-0.15	4.5-6.0	Low----------	0.32			
	16-25	27-35	1.10-1.30	0.2-0.6	0.09-0.12	4.5-6.0	Moderate-----	0.32			
	25-48	55-80	1.10-1.30	0.06-0.2	0.07-0.10	5.1-6.5	High---------	0.32			
	48	---	---	---	---	---	-------------	----			
Rock outcrop.											
25D*:											
Ocie------------	0-6	10-20	1.10-1.40	0.6-2.0	0.18-0.22	5.1-6.5	Low----------	0.43	4	5	.5-2
	6-15	15-27	1.10-1.35	0.6-2.0	0.12-0.15	4.5-6.0	Low----------	0.32			
	15-45	55-80	1.10-1.30	0.06-0.2	0.07-0.10	5.1-6.5	High---------	0.32			
	45	---	---	---	---	---	-------------	----			
Bardley---------	0-3	27-35	1.40-1.55	0.6-2.0	0.12-0.17	4.5-6.5	Moderate-----	0.28	3	8	.5-2
	3-26	60-85	1.20-1.40	0.6-2.0	0.08-0.12	4.5-6.5	High---------	0.28			
	26-29	---	---	---	---	---	-------------	----			
	29	---	---	---	---	---	-------------	----			
Gatewood--------	0-4	15-25	1.10-1.40	0.6-2.0	0.12-0.17	5.1-6.5	Low----------	0.32	3	8	.5-2
	4-34	60-85	1.10-1.30	0.06-0.2	0.09-0.12	5.1-7.3	High---------	0.32			
	34	---	---	---	---	---	-------------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
27D--------------- Bolivar	0-5	12-18	1.30-1.50	2.0-6.0	0.16-0.20	5.1-6.0	Low-----------	0.24	4	3	.5-2
	5-10	20-35	1.40-1.55	0.6-2.0	0.17-0.20	4.5-5.5	Moderate-----	0.32			
	10-32	25-40	1.35-1.55	0.6-2.0	0.08-0.12	3.6-4.4	Moderate-----	0.32			
	32-59	---	---	---	---	---	-------------	----			
	59	---	---	---	---	---	-------------	----			
35D*:											
Doniphan---------	0-7	18-27	1.10-1.30	2.0-6.0	0.08-0.15	4.5-6.5	Low-----------	0.28	2	8	.5-2
	7-13	18-35	1.20-1.40	0.6-2.0	0.10-0.14	3.6-5.5	Moderate-----	0.28			
	13-60	48-70	1.20-1.40	0.6-2.0	0.08-0.10	3.6-5.5	Moderate-----	0.28			
Clarksville------	0-24	14-20	1.30-1.50	2.0-6.0	0.12-0.17	4.5-6.0	Low-----------	0.28	2	8	1-2
	24-38	25-35	1.40-1.65	2.0-6.0	0.06-0.10	4.5-5.5	Low-----------	0.28			
	38-78	40-75	1.40-1.80	2.0-6.0	0.05-0.08	4.5-5.5	Low-----------	0.28			
43C, 43D---------- Goss	0-6	7-27	1.10-1.30	2.0-6.0	0.06-0.17	4.5-6.0	Low-----------	0.24	2	6	1-2
	6-25	20-30	1.10-1.30	2.0-6.0	0.06-0.10	4.5-6.0	Low-----------	0.24			
	25-63	35-60	1.30-1.50	0.6-2.0	0.04-0.09	4.5-7.3	Moderate-----	0.24			
44G*:											
Goss-------------	0-10	7-27	1.10-1.30	2.0-6.0	0.06-0.17	4.5-6.0	Low-----------	0.24	2	6	1-2
	10-25	20-30	1.10-1.30	2.0-6.0	0.06-0.10	4.5-6.0	Low-----------	0.24			
	25-64	35-60	1.30-1.50	0.6-2.0	0.04-0.09	4.5-6.0	Moderate-----	0.24			
Gasconade--------	0-3	35-50	1.35-1.50	0.6-2.0	0.10-0.12	6.1-7.8	Moderate-----	0.20	2	8	2-4
	3-17	35-60	1.45-1.70	0.2-0.6	0.05-0.07	6.1-7.8	Moderate-----	0.20			
	17	---	---	---	---	---	-------------	----			
45D, 45E, 45F, 45G--------------- Clarksville	0-17	14-20	1.30-1.60	2.0-6.0	0.07-0.12	4.5-6.0	Low-----------	0.28	2	8	1-2
	17-36	25-35	1.40-1.65	2.0-6.0	0.06-0.10	4.5-5.5	Low-----------	0.28			
	36-60	40-75	1.40-1.80	2.0-6.0	0.05-0.08	4.5-5.5	Low-----------	0.28			
55A---------------- Huntington	0-11	18-30	1.10-1.30	0.6-2.0	0.18-0.24	5.6-7.8	Low-----------	0.28	5	6	3-6
	11-62	18-30	1.30-1.50	0.6-2.0	0.16-0.22	5.6-7.8	Low-----------	0.32			
81B---------------- Tonti	0-12	10-25	1.30-1.50	0.6-2.0	0.15-0.20	4.5-5.5	Low-----------	0.37	4	5	1-2
	12-22	22-32	1.30-1.50	0.6-2.0	0.12-0.18	4.5-5.5	Low-----------	0.32			
	22-40	18-35	1.40-1.60	0.06-0.2	0.02-0.08	4.5-5.5	Low-----------	0.28			
	40-62	40-55	1.20-1.40	0.6-2.0	0.05-0.10	4.5-5.5	Moderate-----	0.32			
83G*:											
Gasconade--------	0-10	35-50	1.35-1.50	0.6-2.0	0.10-0.12	6.1-7.8	Moderate-----	0.20	2	8	2-4
	10-17	35-60	1.45-1.70	0.2-0.6	0.05-0.07	6.1-7.8	Moderate-----	0.20			
	17	---	---	---	---	---	-------------	----			
Rock outcrop.											
92A*:											
Cedargap---------	0-12	15-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5	6	1-4
	12-42	12-27	1.30-1.50	2.0-6.0	0.10-0.15	5.6-7.3	Low-----------	0.24			
	42-65	25-35	1.40-1.55	2.0-6.0	0.04-0.10	5.6-7.3	Low-----------	0.24			
Secesh-----------	0-10	15-25	1.10-1.30	0.6-2.0	0.16-0.20	5.1-6.5	Low-----------	0.32	3	5	<2
	10-35	20-30	1.20-1.40	0.6-2.0	0.13-0.19	4.5-6.0	Low-----------	0.32			
	35-65	25-35	1.30-1.50	2.0-6.0	0.03-0.08	4.5-6.0	Low-----------	0.24			
93A---------------- Cedargap	0-10	12-25	1.20-1.45	2.0-6.0	0.11-0.18	5.6-7.3	Low-----------	0.24	5	8	1-4
	10-25	12-27	1.30-1.50	2.0-6.0	0.10-0.15	5.6-7.3	Low-----------	0.24			
	25-60	25-35	1.40-1.55	2.0-6.0	0.04-0.10	5.6-7.3	Low-----------	0.24			
94*:											
Pits.											
Dumps.											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
5C----------------- Wilderness	C	None---------	---	---	1.0-2.0	Perched	Dec-Mar	>60	---	Moderate	Low-------	High.
6B----------------- Creldon	C	None---------	---	---	1.5-3.0	Perched	Dec-Apr	>60	---	Moderate	High------	High.
8B*:												
Captina-----------	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	---	High------	High.
Needleye----------	C	None---------	---	---	1.5-3.0	Perched	Dec-Apr	>60	---	Moderate	Moderate	High.
21B----------------- Peridge	B	None---------	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate.
22C----------------- Ocie	C	None---------	---	---	3.0-5.0	Perched	Dec-Mar	40-60	Hard	Moderate	High------	Moderate.
23B----------------- Bolivar	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Low-------	Moderate.
24F*:												
Gatewood----------	C	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	High------	Moderate.
Ocie---------------	C	None---------	---	---	3.0-5.0	Perched	Dec-Mar	40-60	Hard	Moderate	High------	Moderate.
Rock outcrop.												
25D*:												
Ocie---------------	C	None---------	---	---	3.0-5.0	Perched	Dec-Mar	40-60	Hard	Moderate	High------	Moderate.
Bardley-----------	C	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate	Moderate.
Gatewood----------	C	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	High------	Moderate.
27D----------------- Bolivar	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	High.
35D*:												
Doniphan----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	High.
Clarksville-------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	High.
43C, 43D----------- Goss	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
44G*:												
Goss---------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Gasconade---------	D	None---------	---	---	>6.0	---	---	4-20	Hard	Moderate	High------	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
45D, 45E, 45F, 45G----------------- Clarksville	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	High.
55A----------------- Huntington	B	Occasional	Brief------	Dec-May	4.0-6.0	Apparent	Dec-Apr	>60	---	High------	Low-------	Moderate.
81B----------------- Tonti	C	None---------	---	---	1.5-2.5	Perched	Dec-Apr	>60	---	---	High------	High.
83G*:												
Gasconade---------	D	None---------	---	---	>6.0	---	---	4-20	Hard	Moderate	High------	Low.
Rock outcrop.												
92A*:												
Cedargap----------	B	Frequent-----	Very brief	Nov-Mar	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Secesh------------	B	Occasional	Very brief	Nov-Apr	>6.0	---	---	>60	---	Moderate	Low-------	Moderate.
93A----------------- Cedargap	B	Frequent-----	Very brief	Nov-Mar	>6.0	---	---	>60	---	Moderate	Low-------	Low.
94*:												
Pits.												
Dumps.												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bardley	Very-fine, mixed, mesic Typic Hapludalfs
*Bolivar	Fine-loamy, mixed, thermic Ultic Hapludalfs
Captina	Fine-silty, mixed, mesic Typic Fragiudults
Cedargap	Loamy-skeletal, mixed, mesic Cumulic Hapludolls
Clarksville	Loamy-skeletal, siliceous, mesic Typic Paleudults
Creldon	Fine, mixed, mesic Mollic Fragiudalfs
Doniphan	Clayey, mixed, mesic Typic Paleudults
Gasconade	Clayey-skeletal, mixed, mesic Lithic Hapludolls
Gatewood	Very-fine, mixed, mesic Typic Hapludalfs
Goss	Clayey-skeletal, mixed, mesic Typic Paleudalfs
Huntington	Fine-silty, mixed, mesic Fluventic Hapludolls
*Needleye	Fine-silty, mixed, mesic Aquic Fragiudults
Ocie	Loamy-skeletal over clayey, mixed, mesic Typic Hapludalfs
Peridge	Fine-silty, mixed, mesic Typic Paleudalfs
Secesh	Fine-loamy, siliceous, mesic Ultic Hapludalfs
Tonti	Fine-loamy, mixed, mesic Typic Fragiudults
*Wilderness	Loamy-skeletal, siliceous, mesic Typic Fragiudalfs

* The soil is a taxadjunct to the series. See text for description of those characteristics of the soil that are outside the range of the series.

☆U.S. GOVERNMENT PRINTING OFFICE: 1985 O - 419-609 QL 3

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for miscellaneous areas.

SYMBOL	NAME
5C	Wilderness cherty silt loam, 2 to 9 percent slopes
6B	Creldon silt loam, 1 to 4 percent slopes
8B	Captina-Needleye silt loams, 1 to 3 percent slopes
21B	Peridge silt loam, 2 to 5 percent slopes
22C	Ocie cherty silt loam, 2 to 9 percent slopes
23B	Bolivar fine sandy loam, 2 to 5 percent slopes
24F	Gatewood-Ocie-Rock outcrop complex, 9 to 35 percent slopes
25D	Ocie-Bardley-Gatewood complex, 2 to 14 percent slopes
27D	Bolivar stony fine sandy loam, 2 to 14 percent slopes
35D	Doniphan-Clarksville cherty silt loams, 2 to 14 percent slopes
43C	Goss cherty silt loam, 2 to 9 percent slopes
43D	Goss cherty silt loam, 9 to 14 percent slopes
44G	Goss-Gasconade complex, 2 to 50 percent slopes
45D	Clarksville very cherty silt loam, 5 to 14 percent slopes
45E	Clarksville very cherty silt loam, 14 to 20 percent slopes
45F	Clarksville very cherty silt loam, 20 to 35 percent slopes
45G	Clarksville very cherty silt loam, 35 to 60 percent slopes
55A	Huntington silt loam, 0 to 3 percent slopes
81B	Tonti silt loam, 2 to 5 percent slopes
83G	Gasconade-Rock outcrop complex, 9 to 65 percent slopes
92A	Cedargap-Secesh silt loams, 0 to 3 percent slopes
93A	Cedargap cherty silt loam, 0 to 3 percent slopes
94	Pits-Dumps complex

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

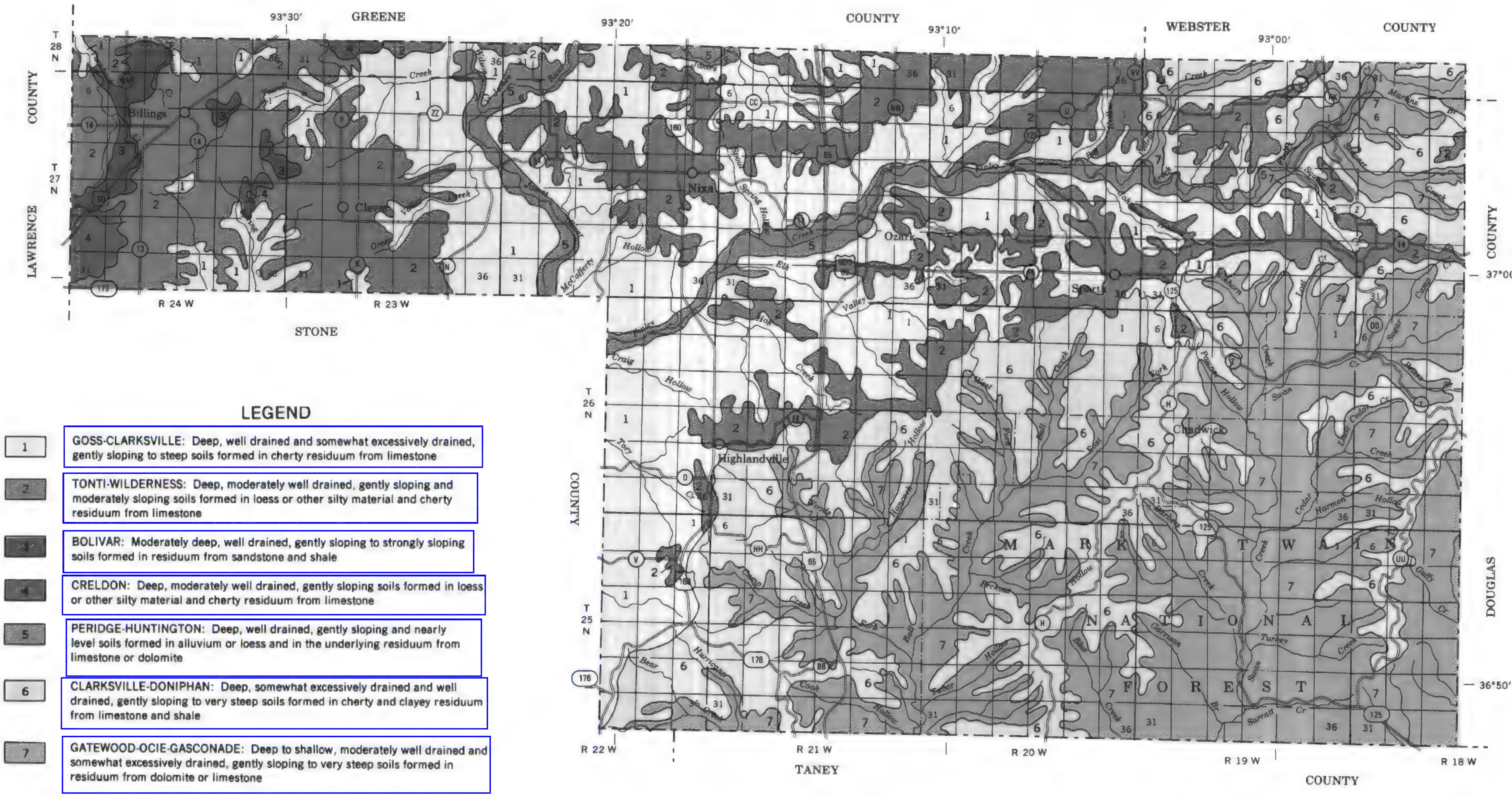
GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot



LEGEND

1 — GOSS-CLARKSVILLE: Deep, well drained and somewhat excessively drained, gently sloping to steep soils formed in cherty residuum from limestone

2 — TONTI-WILDERNESS: Deep, moderately well drained, gently sloping and moderately sloping soils formed in loess or other silty material and cherty residuum from limestone

3 — BOLIVAR: Moderately deep, well drained, gently sloping to strongly sloping soils formed in residuum from sandstone and shale

4 — CRELDON: Deep, moderately well drained, gently sloping soils formed in loess or other silty material and cherty residuum from limestone

5 — PERIDGE-HUNTINGTON: Deep, well drained, gently sloping and nearly level soils formed in alluvium or loess and in the underlying residuum from limestone or dolomite

6 — CLARKSVILLE-DONIPHAN: Deep, somewhat excessively drained and well drained, gently sloping to very steep soils formed in cherty and clayey residuum from limestone and shale

7 — GATEWOOD-OCIE-GASCONADE: Deep to shallow, moderately well drained and somewhat excessively drained, gently sloping to very steep soils formed in residuum from dolomite or limestone

Compiled 1983

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE AND FOREST SERVICE
MISSOURI AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

CHRISTIAN COUNTY, MISSOURI

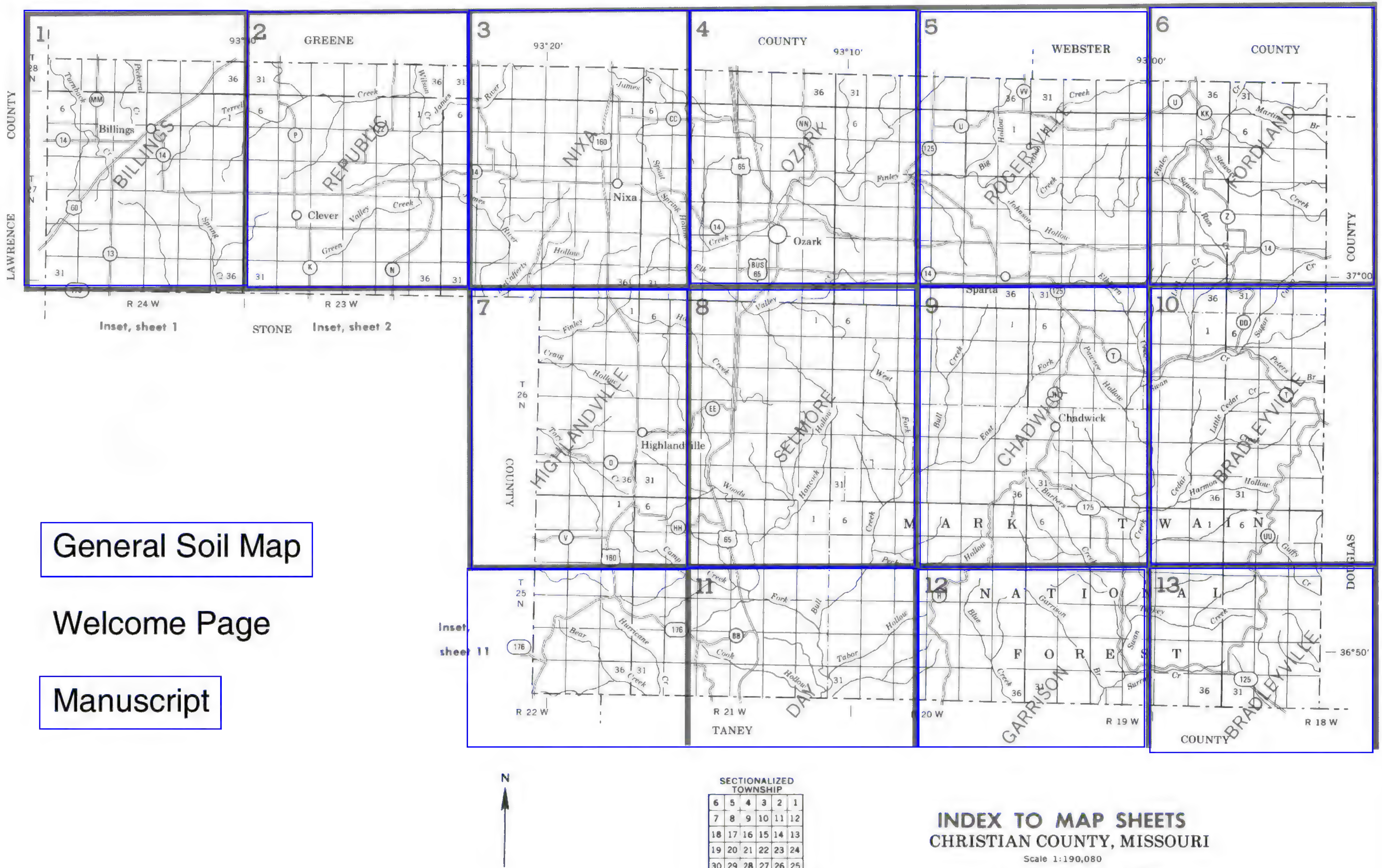
Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

Index Map Welcome Manuscript



General Soil Map

Welcome Page

Manuscript

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
CHRISTIAN COUNTY, MISSOURI

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

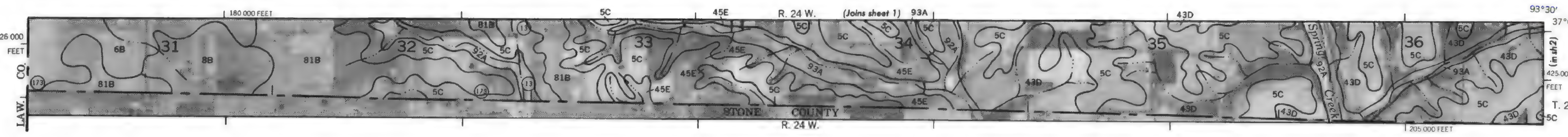
CHRISTIAN COUNTY, MISSOURI

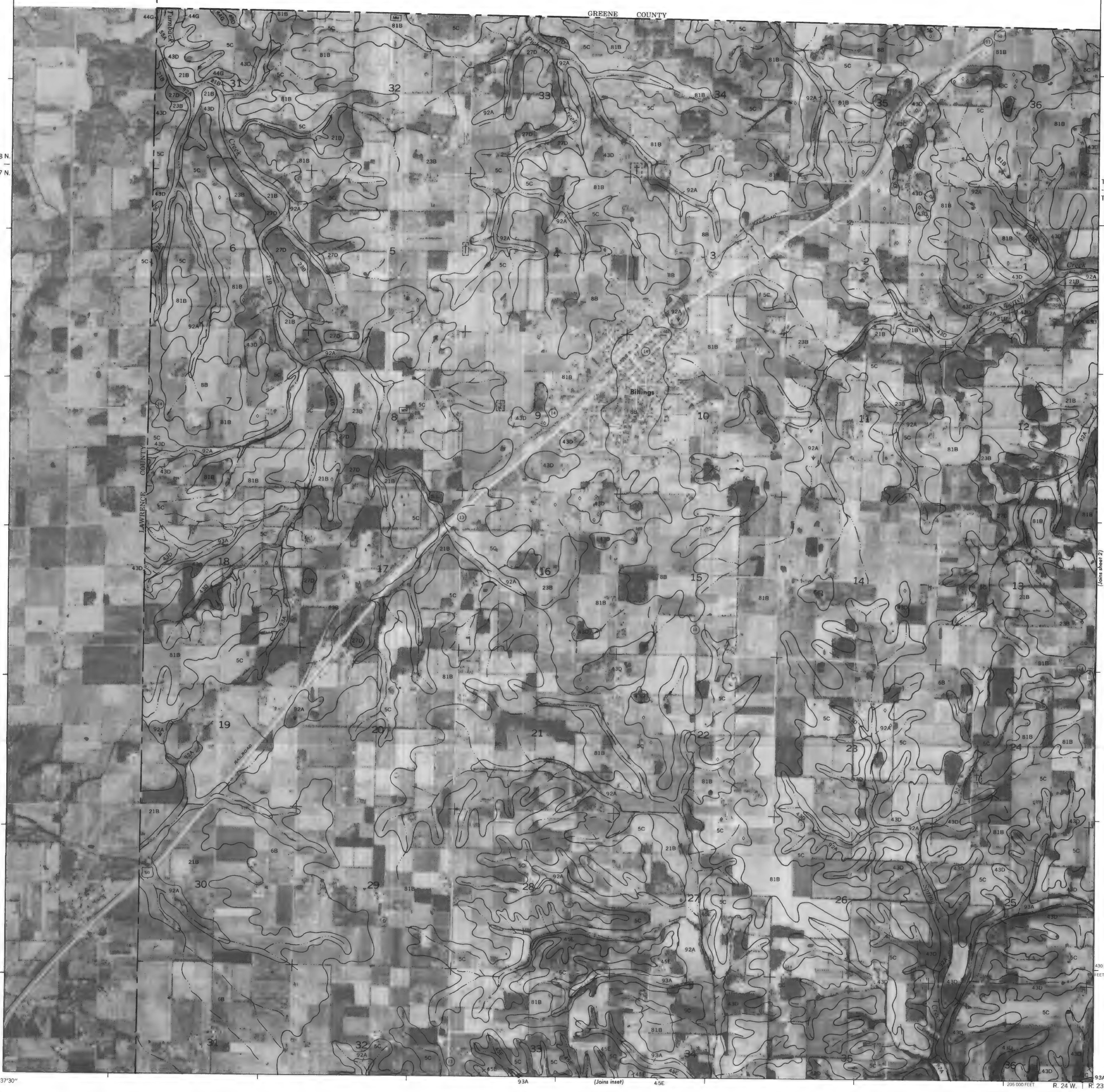
(BILLINGS QUADRANGLE AND PART OF CRANE QUADRANGLE)

Welcome

Manuscript

Index Map





This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

Scale 1:24 000

N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

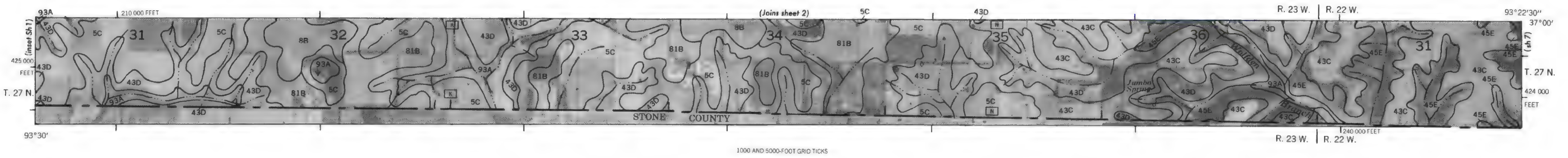
Welcome

Manuscript

Index Map

CHRISTIAN COUNTY, MISSOURI

(REPUBLIC QUADRANGLE AND PART OF HURLEY QUADRANGLE)



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
Scale 1:24000

N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 3
CHRISTIAN COUNTY, MISSOURI
(NIXA QUADRANGLE)

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

Scale 1:24000

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

N

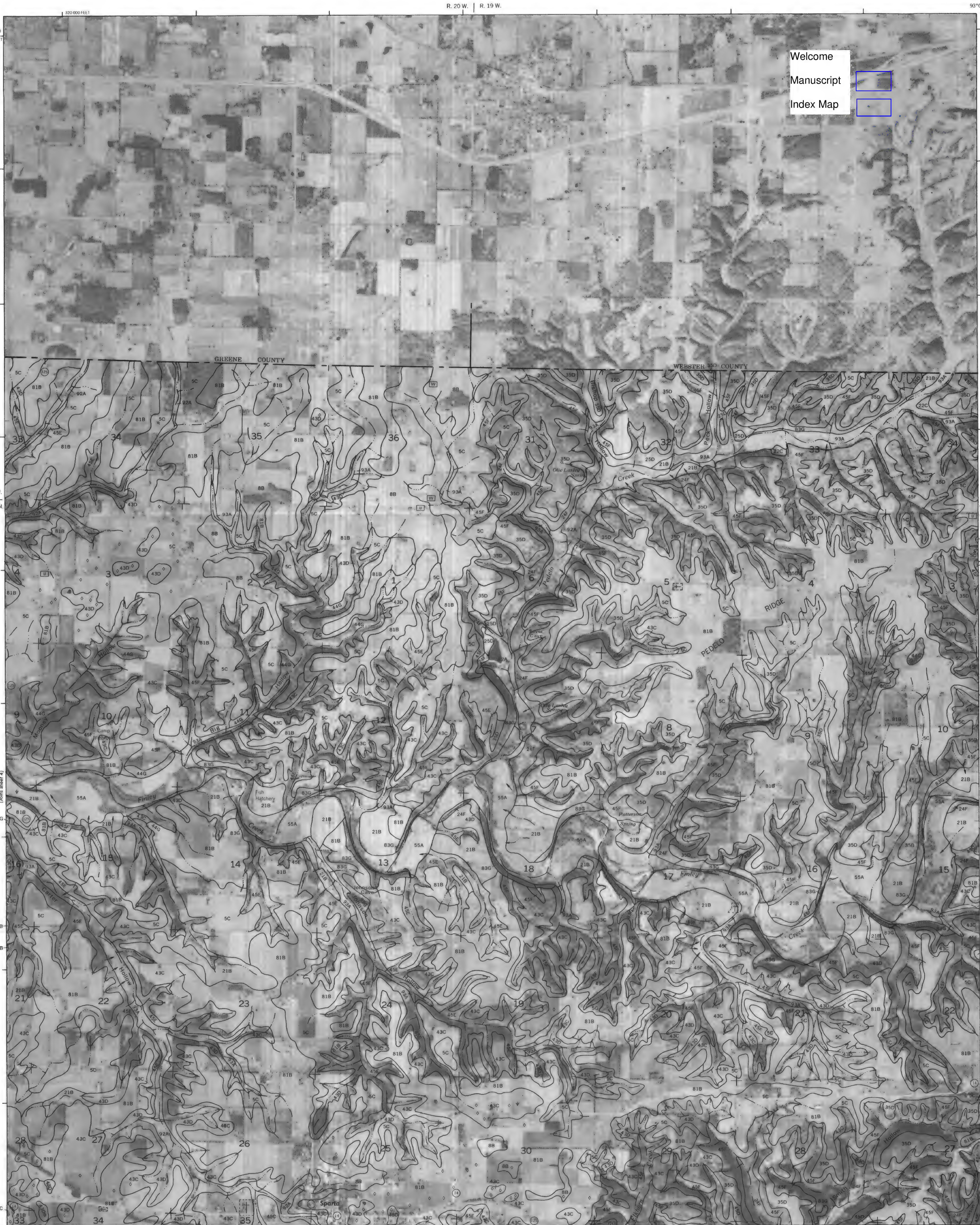
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CHRISTIAN COUNTY, MISSOURI
(OZARK QUADRANGLE)

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
Scale 1:24000

N



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
Scale 1:24 000

N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CHRISTIAN COUNTY, MISSOURI
(FORDLAND QUADRANGLE)

Scale 1:24000

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

N

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

Welcome

Manuscrpt

Index Map

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 7
CHRISTIAN COUNTY, MISSOURI
(HIGHLANDVILLE QUADRANGLE)

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

Scale 1:24000

N

CHRISTIAN COUNTY, MISSOURI NO. 7

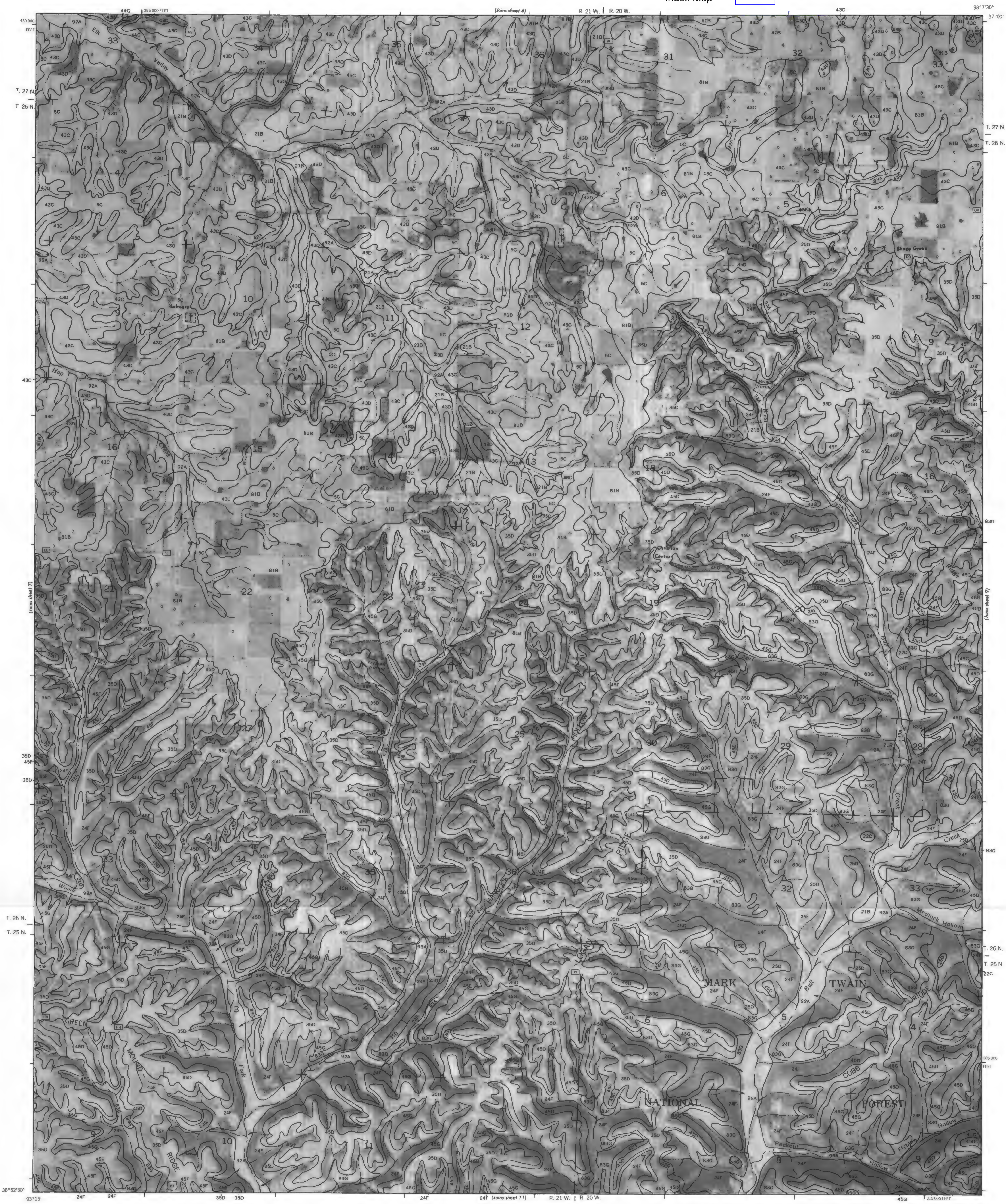
Welcome

Manscript

Index Map

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 8
CHRISTIAN COUNTY, MISSOURI
(SELMORE QUADRANGLE)



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

Scale 1:24000

N

CHRISTIAN COUNTY, MISSOURI NO. 8

Welcome

Manuscript

Index Map

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CHRISTIAN COUNTY, MISSOURI
(CHADWICK QUADRANGLE)

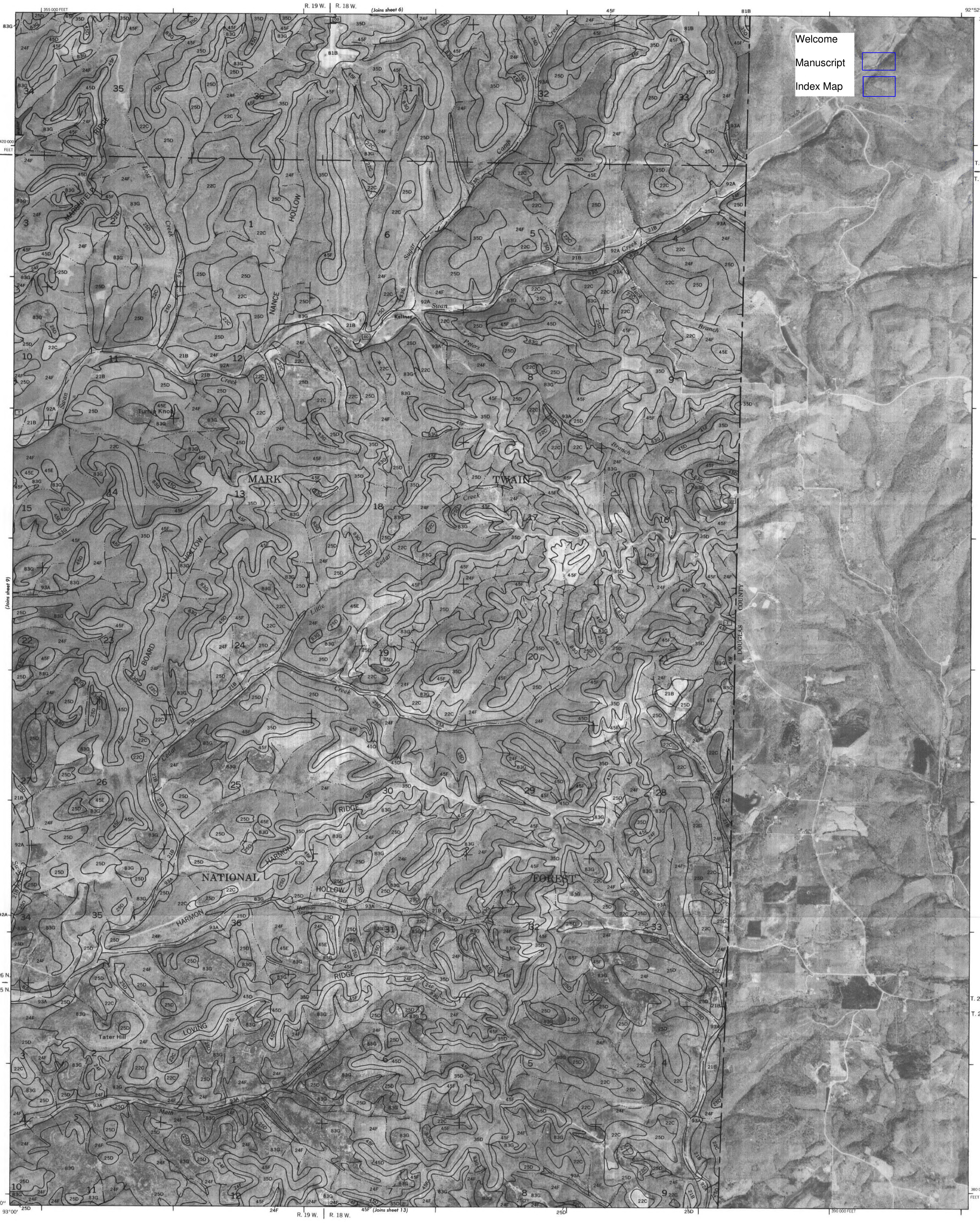
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
Scale 1:24000

N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 10
CHRISTIAN COUNTY, MISSOURI
(BRADLEYVILLE QUADRANGLE)

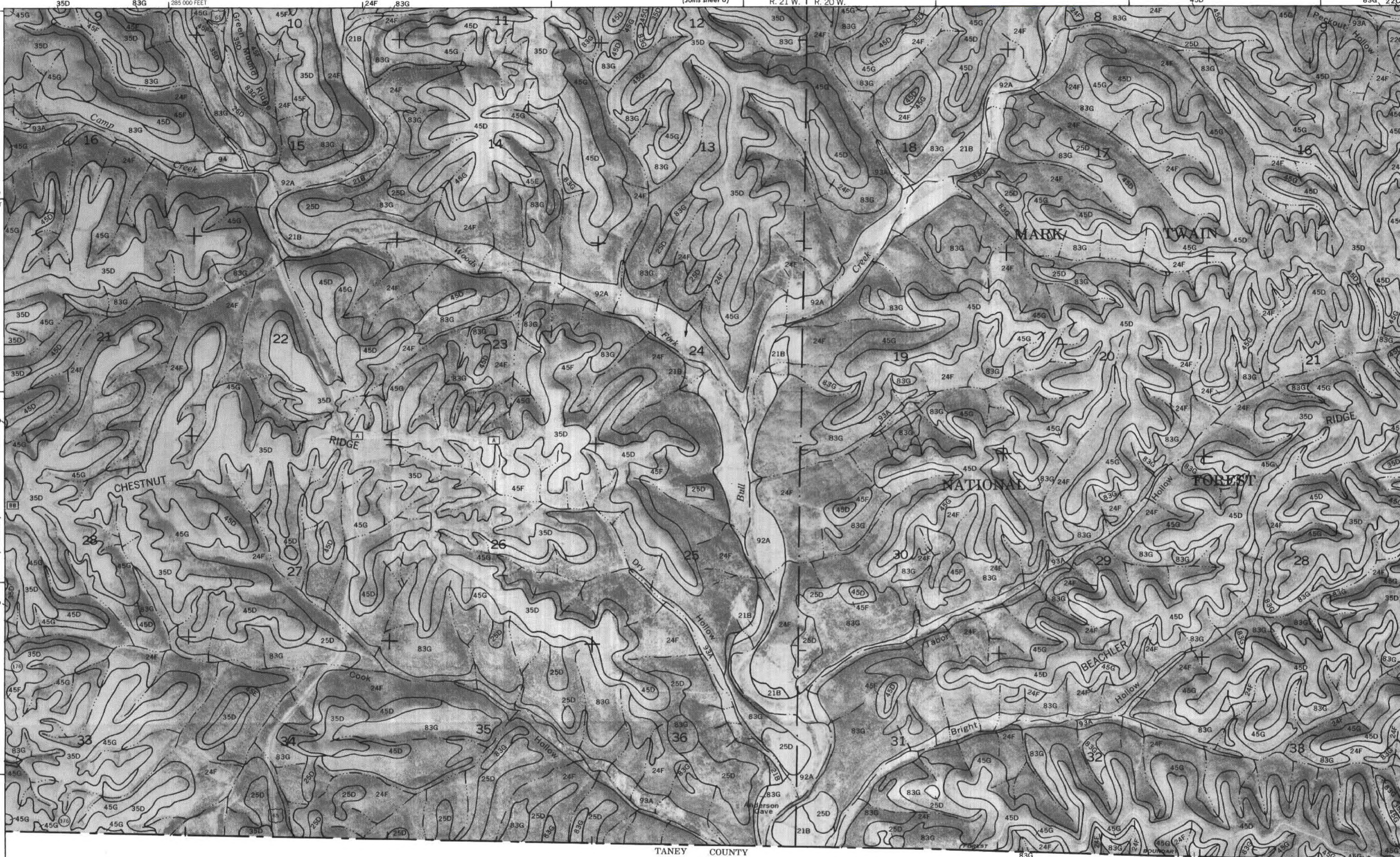


This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
Scale 1:24000

N

Welcome
Manuscript
Index Map



36°45'
93°15'
R. 21 W. | R. 20 W.

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
Scale 1:24000

N

Welcome

Manuscript

Index Map

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 12
CHRISTIAN COUNTY, MISSOURI
(GARRISON QUADRANGLE)

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

Scale 1:24000

N

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1978 and 1980 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

Scale 1:24000

N